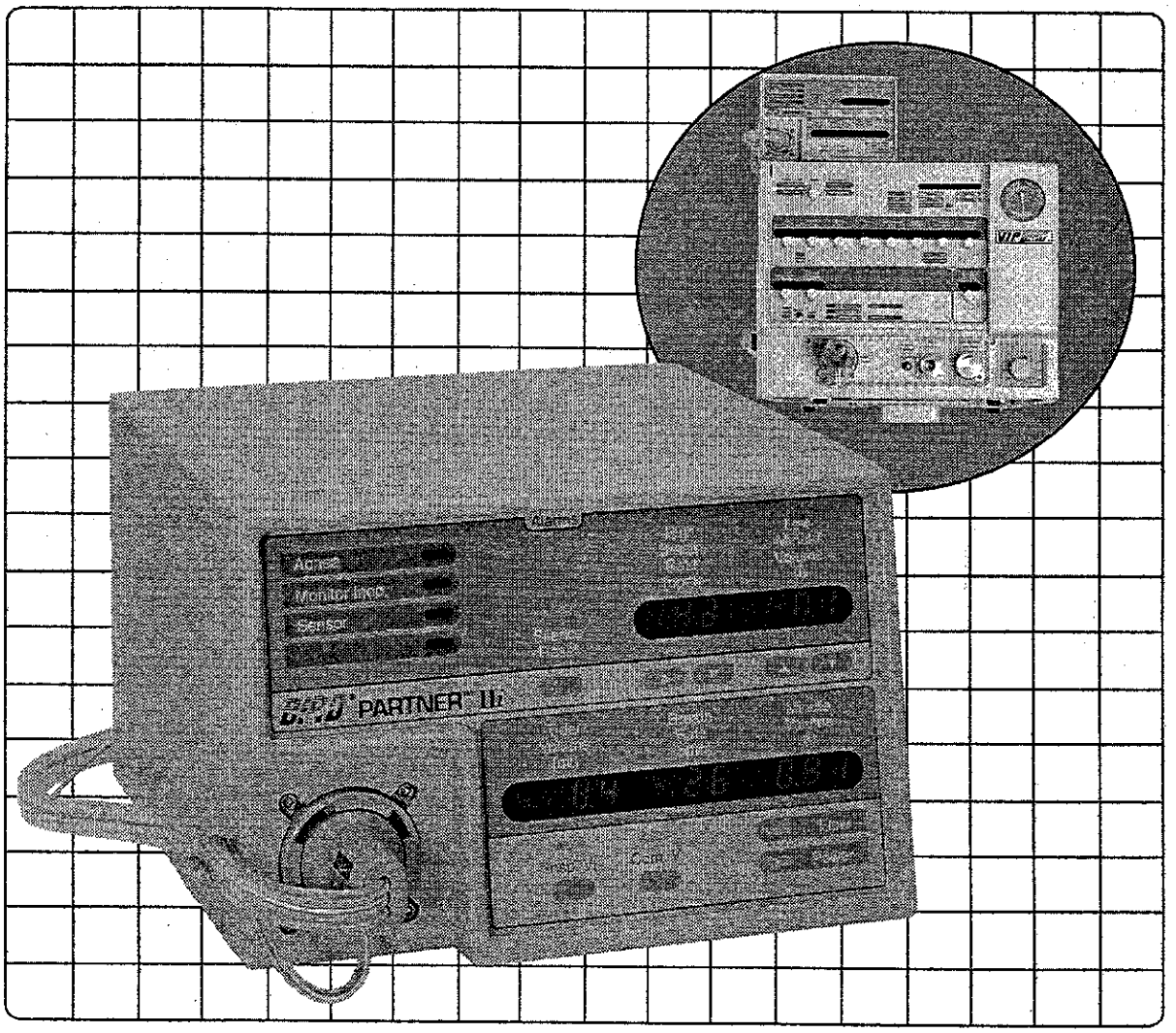
PARTNER® & PARTNER® IIi Volume Monitors



Instruction & Service Manual

L1207D 10/95

PARTNER®/PARTNER® IIi

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ORDERING INFORMATION

Contact your Bird Products Corporation Dealer or Bird Products Corporation **Customer Service Department** directly:

1100 Bird Center Drive
Palm Springs, CA 92262
(800) 328-4139
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TECHNICAL INFORMATION

Contact Bird Products Corporation **Technical Services Department** directly:

1100 Bird Center Drive
Palm Springs, CA 92262
(619) 778-7200 or
BIRD HELPLINE
(800) 934-BIRD
[(800) 934-2473]

Section 1.0
General Information

PARTNER® & PARTNER® IIi Volume Monitors
Instruction & Service Manual

SECTION 1.0: GENERAL INFORMATION

1.1 WARRANTY

The products of Bird Products Corporation (Herein Bird) are warranted to be free from defects in material and workmanship and to meet the published specifications for one (1) year.

The liability of Bird under this warranty is limited to replacing, repairing or issuing credit, at the discretion of Bird, for the parts that become defective or fail to meet published specifications during the warranty period; Bird will not be liable under this warranty unless (A) Bird is promptly notified in writing by Buyer upon discovery of defects or failure to meet specifications; (B) the defective unit or part is returned to Bird, transportation charges prepaid by Buyer; (C) the defective unit or part is received by Bird for adjustment no later than four weeks following the last day of the warranty period; and (D) Bird's examination of such unit or part shall disclose, to its satisfaction, that such defects or failures have not been caused by misuse, neglect, improper installation, unauthorized repair, alteration or accident.

Any authorization of Bird for repair or alteration by the Buyer must be in writing to prevent voiding warranty.

Bird warranties as hereinabove set forth shall not be enlarged, diminished or affected by, and no obligation or liability shall arise or grow out of the rendering of technical advice or service by Bird or its agents in connection with Buyer's order of the products furnished hereunder.

- **LIMITATIONS OF LIABILITIES**

In no event shall Bird be liable to Buyer for loss of profits, loss of use, consequential damage or damages of any kind based upon a claim for breach of warranty, other than the purchase price of any defective product covered hereunder.

This warranty does not cover normal maintenance such as cleaning, adjustment or lubrication and updating of equipment or parts. This warranty shall be void and shall not apply if the equipment is used with accessories or parts not manufactured by Bird or authorized for use in writing by Bird, or if the equipment is not maintained in accordance with a prescribed schedule of maintenance.

The warranty stated above shall extend for a period of one year from date of delivery, with the following exceptions:

1. Electrical components for remote monitoring of physical variables such as temperature, pressure, oxygen saturation or flow are warranted for ninety (90) days from date of receipt.

2. Elastomeric components and other parts or components subject to deterioration over which Bird has not control are warranted for sixty (60) days from date of receipt.

The foregoing is in lieu of any other warranty, expressed or implied, including, without limitation, any warranty of merchantability, except as to title, and can be amended only in writing by a duly authorized representative of Bird.

SECTION 1.0: GENERAL INFORMATION

1.2 USER RESPONSIBILITY

This product will perform in conformity with the description of it contained in this instruction manual and accompanying labels and/or inserts, when assembled, operated, maintained and repaired following the instructions provided. This product must be checked periodically. A defective product should not be used. Parts that are broken, missing, plainly worn, distorted or contaminated should be replaced immediately. If repair or replacement becomes necessary, Bird recommends that a telephonic or written request for service advice be made to the nearest Bird distributor or the Bird Service Center in Palm Springs, California. This product or any of its parts should not be repaired other than following written instructions provided by Bird and by Bird trained personnel. The user of this product shall have the sole responsiblility for any malfunction that results from improper use, faulty maintenance, improper repair, damage or alteration by anyone other than an authorized Bird representative.

1.3 INTRODUCTION

1.3.1 Using this Manual

This manual describes the proper preparation, operation and maintenance of the PARTNER® and PARTNER® II*i* Volume Monitors. Read through the entire manual before using the monitors. The clinician is advised to thoroughly understand the Warnings and Cautions which appear throughout this manual and are summarized in **Section 2.0: WARNINGS AND CAUTIONS.**

This manual describes procedures for two separate volume monitors, the PARTNER and the PARTNER II*i*. The PARTNER may be used with a Pediatric or Adult Flow Sensor **only.** The PARTNER II*i* may be used with a Pediatric or Infant Flow/Volume Sensor **only.** Attempting to use a flow sensor that is not recognized by the base unit will result in a "SENSOR" alarm condition.

Areas in which the operation or function of the PARTNER and PARTNER II*i* base units differ will be noted in this manual using symbols "PVM" and "PII*i*" to denote the PARTNER and PARTNER II*i* respectively.

Read the **USER RESPONSIBILITY STATEMENT;** it lists what is expected of the user to maintain a safe and accurate instrument. Read the **WARRANTY;** it lists Bird's responsibility in case of a functional defect.

Keep this manual available for answering questions which may arise concerning the volume monitor's use, operation, maintenance or repair.

Periodic maintenance procedures in this manual can be performed by the operator.

1.3.2 Description

The PARTNER and PARTNER II*i* are respiratory volume monitors based on a variable orifice differential pressure flow measuring device. The devices consist of a base unit and various sensor types. PARTNER Volume Monitors provide the clinician with the following features:

- Base Unit automatically recognizes and adapts to each comparable sensor type.
- **PARTNER** accepts Pediatric and Adult sensors.
  PARTNER II*i* accepts Infant and Pediatric sensors.
- Variable orifice sensor design, which allows for reduced flow resistance, even at high flow rates.
- Continuous flow function which allows the PARTNER to compensate for various continuous flow rates and allows the Pediatric and Adult flow sensors to be placed downstream during continuous flow conditions, thus decreasing weight and bulk at the endotracheal tube.
- Measurement of infant range inspiratory and expiratory effective volumes when using the PARTNER II*i* with an Infant Flow/Volume Sensor.
- Digital displays of Tidal Volume, Breath Rate and Minute Volume.
- Digital display of real time flow signal (Infant Sensors).
- Digital displays for setting High Breath Rate and Low Minute Volume alarms.
- Adjustable Apnea Interval (10 to 60 seconds in 5 second increments).

SECTION 1.0: GENERAL INFORMATION

1.4 PRODUCT SPECIFICATIONS

SENSORS

Infant Trigger:

Infant Flow/Volume:

Flow Range	0.2 to 20 LPM
Accuracy	± 10% or 0.2 LPM, whichever is greater
Deadspace	< 1 ml

Pediatric:

Flow Range	2.0 to 120 LPM
Accuracy	± 5%

Adult:

Flow Range	4.0 to 250 LPM
Accuracy	± 5%

CONTROLS

Power ON/OFF	"On"/"OFF" Switch
Continuous Flow Compensation	Switch Activated
(Pediatric and Adult Sensors Only) Range	3 to 60 LPM
Real Time Flow	Switch Activated Signal
(Infant Trigger and Flow/Volume Sensors Only)	
Inspiratory Tidal Volume: (PIIi only)	Switch Activated
Flow Range	
(Infant Flow/Volume sensor only)	0.2 to 20 LPM

MONITORS/INDICATORS

Tidal Volume:

Display Range: ..... 0 to 9999 ml
Resolution:
- PII*i* Infant ..... 0.1 ml
- PII*i* and PVM Pediatric ..... 1.0 ml
- PVM Adult ..... 1.0 ml

Minute Volume:

Display Range ..... 0.0 to 99.9 L
Resolution:
- PII*i* Infant ..... 0.01 L
- PII*i* and PVM Pediatric ..... 0.1 L
- PVM Adult ..... 0.1 L

Breath Rate:

Display Range ..... 0 to 999 BPM
Resolution ..... 1 BPM
Accuracy ..... ± 1 BPM

Environmental Requirements:

Storage Temperature ..... -40 to +70° C
Operating Temperature ..... +15 to 40° C

Flow: LED Lights When Flow Is Within Measurable Range

Infant Trigger and Flow/Volume Sensors ..... 0.2 to 20 LPM
Pediatric Sensor ..... 2.0 to 120 LPM
Adult Sensor ..... 4.0 to 250 LPM

SECTION 1.0: GENERAL INFORMATION

ALARMS/ALERTS

Silence: ..... 60 seconds

Low Minute Volume:

Range ..... OFF (Infant F/V Sensor only), 0.0 to 99.9 L
Resolution ..... 0.1 L

High Breath Rate:

Range ..... 0 to 999 BPM
Resolution ..... 1 BPM

Apnea:

Range ..... 10 to 60 seconds in 5 second increments

Sensor: ..... Audible/Visual alarm indicating sensor is not properly connected or malfunction of sensor heating system (PIIi only)

Power: ..... Audible/Visual alarm indicating power failure

Monitor Inoperative: ..... Audible/Visual alarm indicating power supply out of range, failure of Power On Self Test, or the ON/OFF switch has been changed from the "ON" (I) to the "OFF" (O) position or internal malfunction

ELECTRICAL/POWER REQUIREMENTS

Power Requirements: ..... 100 VAC, 50/60 Hz, 0.2A
120 VAC, 50/60 Hz, 0.2A
220 VAC, 50/60 Hz, 0.1A
240 VAC, 50/60 Hz, 0.1A

COMMUNICATIONS

Data Out: ..... High speed fiber optic link for transmitting all monitored data, alarm settings and alarm status.

Data In: ..... High speed fiber optic link for receiving data from the 6400ST Volume Ventilator and V.I.P. BIRD Infant-Pediatric Ventilator.

WEIGHTS & DIMENSIONS

Physical Weights & Dimensions:

Dimensions ..... H - 5" (12.7cm)
W - 7 1/2" (19.1 cm)
D - 7 1/2 " (19.1 cm)

Weight ..... 7 lbs (3.2 kg)

Shipping Information:

Dimensions ..... H - 8 3/4" (22.2cm)
W - 13 1/8" (33.3 cm)
D - 11 1/4 " (28.6 cm)

Weight ..... 9 1/2 lbs (4.3 kg)

NOTE: Bird Products Corporation reserves the right to change these specifications without notice.

1.5 ORDERING INFORMATION

Part No.	Description
15060	PARTNER Volume Monitor, Complete, 120V 50/60 Hz
15060C	PARTNER Volume Monitor, Complete, 220V 50/60 Hz
15285	PARTNER II*i* Volume Monitor, Complete, 120V 50/60 Hz
15285C	PARTNER II*i* Volume Monitor, Complete, 220V 50/60 Hz

1.5.1 Recommended Accessories

Part No.	Description
10109*	V.I.P. BIRD Mounting Bracket
10173R	Adult Flow Sensor Assembly
10174R	Pediatric Flow Sensor Assembly
10184	Pole Bracket
10187	V.I.P BIRD Mounting Assembly (includes 10109 & 10195)
10192	Overhead Rack (6400ST, 8400ST and V.I.P. BIRD)
10193	Rail Bracket
10195	Rail Kit
15420	Infant Flow/Volume Sensor Assembly

** Requires P/N 10195 (Rail Kit)*

1.6 MOUNTING OPTIONS

1.6.1 6400ST® Mounting Option

1. The PARTNER Volume Monitor can be mounted to either side rail of the 6400ST by use of P/N 10193 (Rail Bracket). This rail bracket and the underside of the PARTNER have appropriate hole patterns so that the volume monitor can be mounted "face forward" on either side rail.

2. The PARTNER can be mounted above the 6400ST by use of P/N 10192 (Overhead Rack). This rack contains both an overhead rail and a tray. The tray comes complete with hole patterns to secure the PARTNER.

3. The PARTNER can be mounted beneath the 6400ST ventilator head by use of P/N 10184 (Pole Bracket) and P/N 03296 (Universal Humidifier Bracket with 1" Pole).

1.6.2 V.I.P. BIRD® Mounting Option

1. The PARTNER can be mounted to the top cover of the V.I.P. BIRD by the use of P/N 10187 (V.I.P. BIRD mounting assembly which includes P/N 10109 & P/N 10195). The mounting assembly allows the PARTNER to be secured to the cover of the V.I.P. BIRD with the front panel of the PARTNER "face forward".

   This mounting configuration is recommended if the user intends to mount the optional Bird® Graphics Monitor to the V.I.P. BIRD.

2. The PARTNER can be mounted above the V.I.P. BIRD by use of P/N 10192 (Overhead Rack). This rack contains both an overhead rail and a tray. The tray comes complete with hole patterns to secure the PARTNER.

NOTE: If the Bird® Graphics Monitor is anticipated as an addition, P/N 10192 (Overhead Rack) cannot be used.

3. The PARTNER can be mounted beneath the V.I.P. BIRD by use of P/N 10184 (Pole Bracket) and P/N 03296 (Universal Humidifier Bracket with 1" Pole).

4. The PARTNER can be mounted to either side rail of the V.I.P. BIRD by use of P/N 10193 (Rail Bracket). This rail bracket and the underside of the PARTNER have appropriate hole patterns so that the volume monitor can be mounted "face forward" on either side rail.

Section 2.0

Warnings, Cautions & Notes

PARTNER® & PARTNER® II*i* Volume Monitors
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SECTION 2.0: WARNINGS, CAUTIONS & NOTES

The PARTNER and PARTNER II*i* volume monitors should be operated by trained, qualified medical personnel under the direct supervision of a licensed physician. Before clinical application, the WARNINGS AND CAUTIONS should be read and understood.

2.1 DEFINITIONS

WARNING ! — **Conditions may exist that could adversely affect the operator or patient.**

CAUTION ✔ — Conditions may exist that could damage the ventilator or other pieces of equipment.

NOTE: — A specific point made to assist the operator in understanding the equipment.

2.2 WARNINGS

WARNINGS !

- Although it does not affect sensor accuracy, placement of tubing between the infant sensors and the endotracheal tube will increase the "deadspace" volume of the circuit. Care should be taken to ensure that adequate ventilation is maintained if tubing is placed between the endotracheal tube and the sensor.

- If it is necessary to disconnect the patient circuit from the endotracheal tube in order to activate the Cont. $\dot{V}$ feature, ensure that the patient receives adequate ventilation by alternative means, such as a hand resuscitation device.

- Infant trigger and flow/volume sensors MUST be cleaned at least every 24 hours in order to maintain accurate volume monitoring and triggering capabilities.

  - Heavy patient secretions will necessitate more frequent cleaning.

  - After soaking in a sterilizing solution the Infant sensors MUST be rinsed in sterile, distilled water.

  - **Do not** rinse cleaning solution from these sensors with a saline solution or tap water after sterilization. Over time, salt deposits will build up on the sensor element and adversely affect sensor function.

SECTION 2.0: WARNINGS, CAUTIONS & NOTES

WARNINGS !

- Purge gas for the PARTNER must be supplied from the auxiliary gas port on the V.I.P. BIRD to ensure that the purge gas is at the same air/O_2 mixture as that being delivered to the patient by the ventilator. Use of either pure air or oxygen as a purge gas source may result in improper FIO_2 delivered to the patient in the event of a purge solenoid leak.

- **Do not** connect a fiber optic cable between the DATA OUT port on a V.I.P. BIRD Ventilator and the DATA IN port on a PARTNER Monitor which has software revision 92:21 or earlier. If connected, the PARTNER Monitor will detect flow, i.e. Flow LED will illuminate, however, the Tidal Volume, Breath Rate and Minute Volume displays will read zero and the Low Minute Volume alarm will activate.

- All infant flow sensors are designed and manufactured to accurately and repeatably measure flow. Extended usage, failure to thoroughly clean the sensor, and exposure to harsh environments such as moisture, chemicals, and sterilization can, however, degrade the performance of the device over time. The warranty period for flow sensors is ninety (90) days from the date of purchase.

2.3 CAUTIONS

CAUTIONS ✔

- ✔ **Do not** insert cleaning instruments (brushes, pipe cleaners, etc.) into the flow sensor or direct gas under high pressure into the flow sensor. Damage to the flow element could result and cause inaccurate volume measurement.

- ✔ **Do not** attempt to clear accumulated liquid from the pressure sensing lines by using high velocity gas devices such as a jet nozzle. This will result in damage to the sensor head and inaccurate flow measurements and/or a "Monitor Inop" condition.

- ✔ When using a liquid sterilization process on the flow sensor assembly, ensure that the pressure sensing lines are **completely** dry before returning the sensor to use. Failure to do so will result in inaccurate volume measurement and/or a "Monitor Inop" condition.

- ✔ The operator should routinely inspect the two rubber O-rings located in the sensor receptacle on the base unit (refer to Figure 4.1 on page 4-1). If these O-rings are found to be missing or damaged they must be replaced before the monitor is returned to service.

CAUTIONS ✔

- ✔ **Do not** spray cleaning solutions directly on the base unit. This may damage internal components. Wipe base unit with a cloth moistened with an appropriate cleaning solution.

- ✔ **Do not** attempt to remove the sensor connector and attach it to another sensor. This will cause false sensor recognition and choice of calibration curve by the base unit microprocessor. Inaccurate volume monitoring will occur.

- ✔ **Do not** sterilize the infant flow/volume or infant trigger sensors by pasteurization or steam autoclave. The material used in the flow element is not compatible with temperatures in excess of 150° fahrenheit. Exposure to temperatures above this level may result in damage to the sensor.

- ✔ Each sensor assembly (flow sensor, pressure tubing and connector) is manufactured to remain together as a single piece. Disconnection of any of the component parts of the assembly could severely affect the sensor's accuracy.

- ✔ The operator must periodically check to ensure that the pressure sensing lines are not crimped. This could cause inaccurate volume readings and build up of purge gas pressure.

- ✔ To avoid damage to internal components, use only clean, dry medical grade gas as a purge gas source.

- ✔ **Do not** autoclave the monitor base unit. **Do not** sterilize the base unit by gas or liquid techniques. **Do not** expose the base unit to temperatures in excess of 158 °F (70 °C).

- ✔ Use recommended cleaning solution sparingly. **Do not** saturate sensor receptacle (located on monitor base unit).

- ✔ Placement of sensors in areas other than described in Section 3.3 may result in inaccurate volume measurement and/or improper function of the CONT. $\dot{V}$ and/or INSP. V_t functions.

- ✔ **Do not** touch the heat sinks on the PARTNER Power Board (P/N 50110), as they are hot.

Section 3.0
Operating Instructions

PARTNER® & PARTNER® IIi Volume Monitors
Instruction & Service Manual

SECTION 3.0: OPERATING INSTRUCTIONS

3.1 THEORY OF OPERATION

The following Warnings and Notes apply to this section. It is highly recommended that you read and understand this material before proceeding.

CAUTIONS ✔

- ✔ **Do not** insert cleaning instruments (brushes, pipe cleaners, etc.) into the flow sensor or direct gas under high pressure into the flow sensor. Damage to the flow element could result and cause inaccurate volume measurement.

- ✔ **Do not** attempt to clear accumulated liquid from the pressure sensing lines by using high velocity gas devices such as a jet nozzle. This will result in damage to the sensor head and inaccurate flow measurements and/or a "Monitor Inop" condition.

- ✔ The operator must periodically check to ensure that the pressure sensing lines are not crimped. This could cause inaccurate volume readings and build up of purge gas pressure.

- ✔ When using a liquid sterilization process on the flow sensor assembly, ensure that the pressure sensing lines are **completely** dry before returning the sensor to use. Failure to do so will result in inaccurate volume measurement and/or a "Monitor Inop" condition.

- ✔ The operator should routinely inspect the two rubber O-rings located in the sensor receptacle on the base unit (refer to Figure 4.1 on page 4-1). If these O-rings are found to be missing or damaged they must be replaced before the monitor is returned to service.

- ✔ **Do not** attempt to remove the sensor connector and attach it to another sensor. This will cause false sensor recognition and choice of calibration curve by the base unit microprocessor. Inaccurate volume monitoring will occur.

- ✔ Each sensor assembly (flow sensor, pressure tubing and connector) is manufactured to remain together as a single piece. Disconnection of any of the component parts of the assembly could severely affect the sensor's accuracy.

- ✔ To avoid damage to internal components, use only clean, dry medical grade gas as a purge gas source.

- ✔ Placement of sensors in areas other than described in Section 3.3 may result in inaccurate volume measurement and/or improper function of the Cont. $\dot{V}$ and/or INSP. V_t functions.

NOTES:

- The wire "cross hairs" at either end of the flow sensor are meant to prevent the insertion of cleaning tools into the flow sensor. Refer to Section 3.5: Cleaning & Sterilization for recommended cleaning procedures.

- The Infant Trigger and Infant Flow/Volume are designed for use between the patient circuit "wye" and the endotracheal tube. In this position, they are not affected by continuous flow and Continuous Flow Compensation is NOT required when using this sensor. When either Infant Sensor is installed in the Base Unit the function of the Cont. V button is changed to display the real time flow signal from the Infant sensor at the patient "wye".

- It is recommended that Continuous Flow Compensation not be used with certain mechanical ventilators that employ a continuous flow system using compliant reservoir bags. These bags tend to distend during the delivery of a mechanical breath and then add the distension volume to the patient's exhaled volume. This will result in measurement of both volume from the reservoir bag and volume from the patient, resulting in larger than actual exhaled tidal volumes.

3.1.1 Volume Measurement

The PARTNER and PARTNER II*i* volume monitors are microprocessor based volume monitoring devices. Volume measurement is derived from the measurement of flow.

Flow measurement is accomplished by a variable orifice differential pressure flow sensor (item #B in Figures 3.1 & 3.2). As gas travels through the sensor, it travels past a variable orifice flow element (item #A in Figures 3.1 & 3.2) which resides between two chambers in the sensor. The flow element creates a small difference in pressure between the two chambers. When a flow sensor assembly is properly attached to the base unit, the pressures in the chambers are transmitted to a differential pressure transducer which measures the difference in pressure between the two chambers of the sensor.

The differential pressure transducer then sends an analog signal which is digitized and "read" by the microprocessor in the base unit. Every millisecond the microprocessor compares this signal to a known calibration curve and translates it to a volume. These volumes are accumulated and displayed at the end of the measurement period.

Figure 3.1
Adult
Pediatric
Infant Trigger

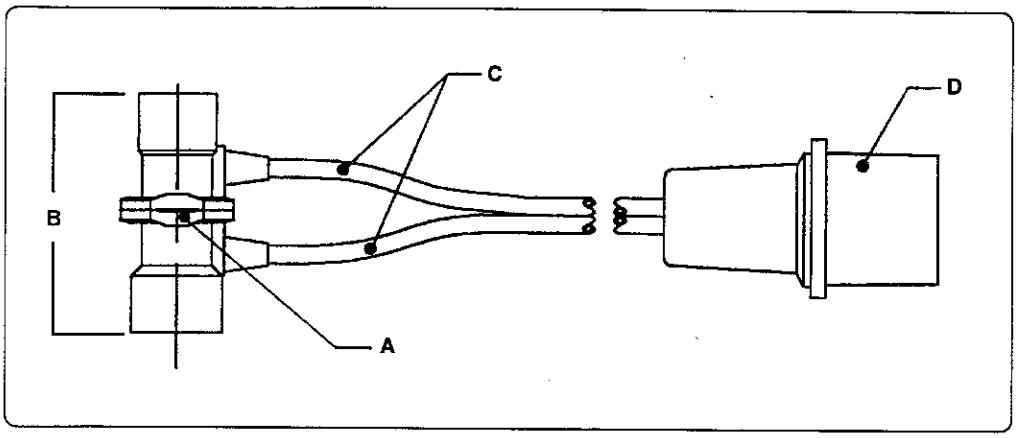
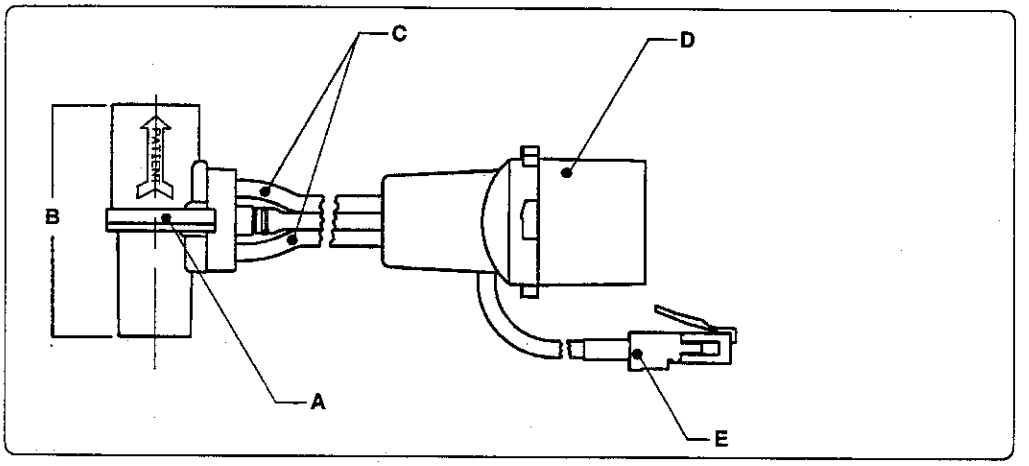


Figure 3.2
Infant
Flow/Volume



3.1.2 Flow Sensor Assembly

Each Flow Sensor Assembly consists of a flow sensor, pressure sensing lines and an optically coded connector. Additionally, the Infant Flow/Volume Sensor has an electrical supply cable to power the heater element in the sensor head. This cable attaches to the rear panel of the Partner II*i* via a telephone type connector (item #E in Figures 3.1 & 3.2).

3.1.2.1 **Flow Sensor (item #B, above)** – The flow sensor consists of two chambers separated by a variable orifice flow element (item #A, above). The flow element bends in the direction of flow and creates a small pressure difference between the two chambers. The difference in pressure is dependent on the amount of flow passing by the flow element. Since the flow element is made from a material whose properties are known and remain constant for millions of cycles, the relationship between pressure and flow is known for each sensor type and thus can be used by the microprocessor to determine the flow rate.

3.1.2.2 **Pressure Sensing Lines (item #C, above)** – The pressure sensing lines connected to both the flow sensor and sensor connector are not removable. The purpose of this tubing is to transmit the pressure in each chamber of the flow sensor to the differential pressure transducer in the base unit.

3.1.2.3 **Sensor Connector (item #D, Figures 3.1 & 3.2)** – The sensor connector attaches the sensor assembly to the base unit. Each sensor connector is optically coded to identify sensor type and flow element characteristics to the microprocessor in the base unit.

3.1.3 Heating System

(PARTNER II*i* with Infant Flow/Volume Sensor only)

A heating element is incorporated into the Infant Flow/Volume Sensor to maintain near body temperature within the sensor head so that condensation or "rainout" will be minimized. The heating element is powered from a cable that attaches to the back of the PARTNER II*i* via a telephone type connector (item #E in Figure 3.2).

3.1.4 Sensor Recognition and Choice of Calibration Curves

Each sensor connector is optically coded. The microprocessor in the base unit "reads" this code and is thus able to differentiate between sensor types (Infant Trigger, Infant Flow/Volume, Adult and Pediatric) and determine the best calibration curve to use for each sensor's particular flow element. This occurs automatically each time a sensor is properly inserted into the base unit.

3.1.5 Continuous Flow Compensation (Cont. $\dot{V}$)

The Adult and Pediatric Flow Sensors have been designed for placement in the circuit just before the exhalation valve. During continuous flow oxygen therapy or continuous flow ventilation modes, volume measurement can be affected by the continuous flow of gas through the Pediatric or Adult Flow Sensors.

Depression of the Continuous Flow (Cont. $\dot{V}$) button (refer to Figures 3.3 & 3.4) will "zero" flow measurement to whatever level of continuous flow is passing through the sensor at the time the button was depressed. In effect, the volume monitor ignores anything below the "zero" level of flow and measures anything above the "zero" level of flow.

Continuous Flow Compensation allows the Adult and Pediatric Sensors to be placed in the circuit just before the exhalation valve, thus limiting bulk and weight at the endotracheal tube. It is recommended that Continuous Flow Compensation not be used with certain mechanical ventilators that employ a continuous flow system using compliant reservoir bags. These bags tend to distend during the delivery of a mechanical breath and then add the distension volume to the patient's exhaled volume. This will result in measurement of both volume from the reservoir bag and volume from the patient, resulting in larger than actual exhaled tidal volumes.

3.1.6 Inspiratory Volume Measurement

When using the Infant Flow/Volume Sensor between the circuit "wye" and the endotracheal tube, depression of the Insp. V_t button (refer to Figure 3.4) causes the microprocessor to ignore flow measurement in the direction of the arrow on the sensor and measure all flow occurring in the opposite direction. When the sensor is properly placed, with the arrow pointing toward the endotracheal tube, depression of the button results in the measurement and display of effective inspiratory tidal volume.

3.1.7 Pressure Sensing Line Purge

When the gas inlet, located on the back of the unit (item #A in Fig. 3.5 & 3.6), is attached to a 50 psi blended gas source, approx. 12 ml of gas is sent down the pressure sensing lines every minute. Activation of the purge is synchronized to the patient's exhalation so that no additional volume is delivered to the patient when an Infant Trigger or Flow/Volume Sensor is placed at the patient wye with the arrow on the sensor pointing toward the patient.

The purpose of this purge is to prevent blockage of the pressure sensing lines and water migration to the differential pressure transducer.

When attached to a V.I.P. BIRD, the purge gas source line must be connected to the auxiliary mixed gas port on the side of the ventilator. This will supply purge gas at the same oxygen concentration as that being delivered to the patient by the ventilator.

3.1.8 Auto Zero Function

The differential pressure transducer is automatically zeroed every minute during the pressure sensing line purge.

3.1.9 Fiber Optic Data Transmission between the PARTNER and the 6400ST® Ventilator

PARTNER has been designed to receive data from the 6400ST. Using a fiber optic data transmission cable, the PARTNER is signalled as to when the 6400ST is in the inspiratory and expiratory phases of the breathing cycle. This allows the monitor to differentiate between multiple breaths and a single exhalation interrupted by short duration pauses, such as can be found with the application of PEEP or water buildup in the circuit.

3.1.10 Fiber Optic Link to the V.I.P. BIRD® Infant-Pediatric Ventilator

The fiber optic link transmits breath phase information from the V.I.P. BIRD to the PARTNER. This facilitates timing of the PARTNER pressure sensing line purge and allows the PARTNER to measure exhaled volumes accurately with the V.I.P. BIRD in the Time Cycled mode and the Flow control set to greater than 15 LPM (i.e. inspiratory peak flow greater than expiratory continuous flow).

SECTION 3.0: OPERATING INSTRUCTIONS

Figure 3.3
PARTNER
Volume Monitor
Front View

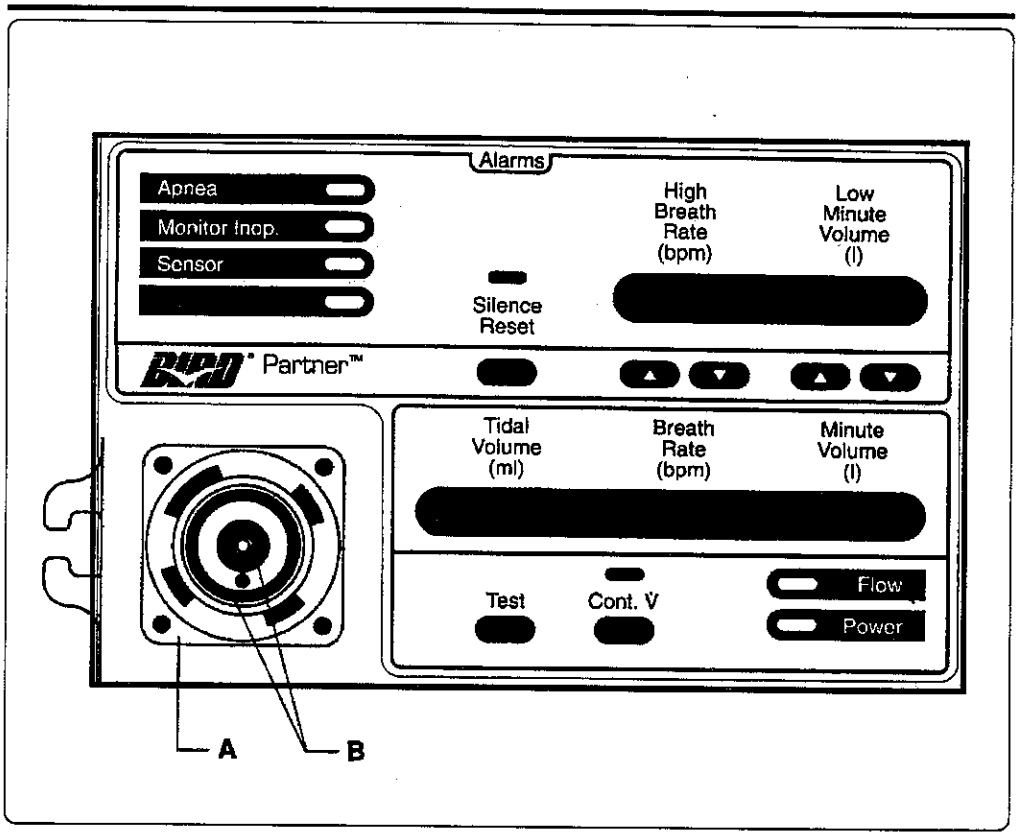


Figure 3.4
PARTNER II*i*
Volume Monitor
Front View

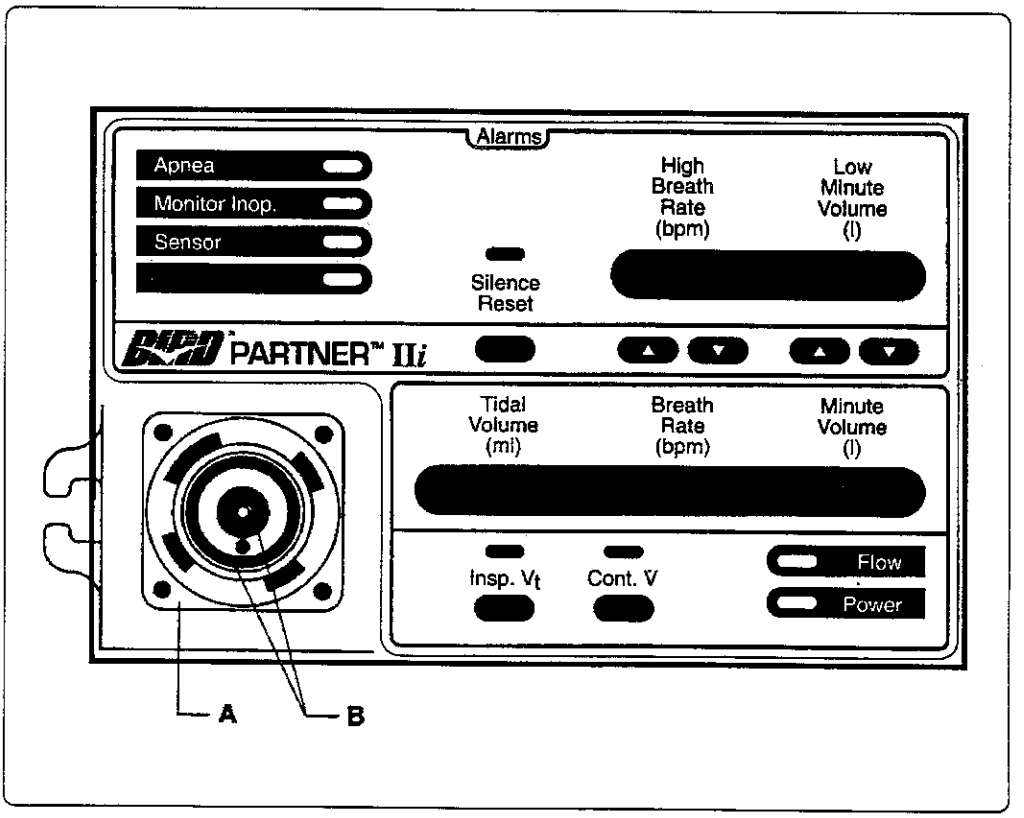


Figure 3.5
PARTNER
Volume Monitor
Rear View

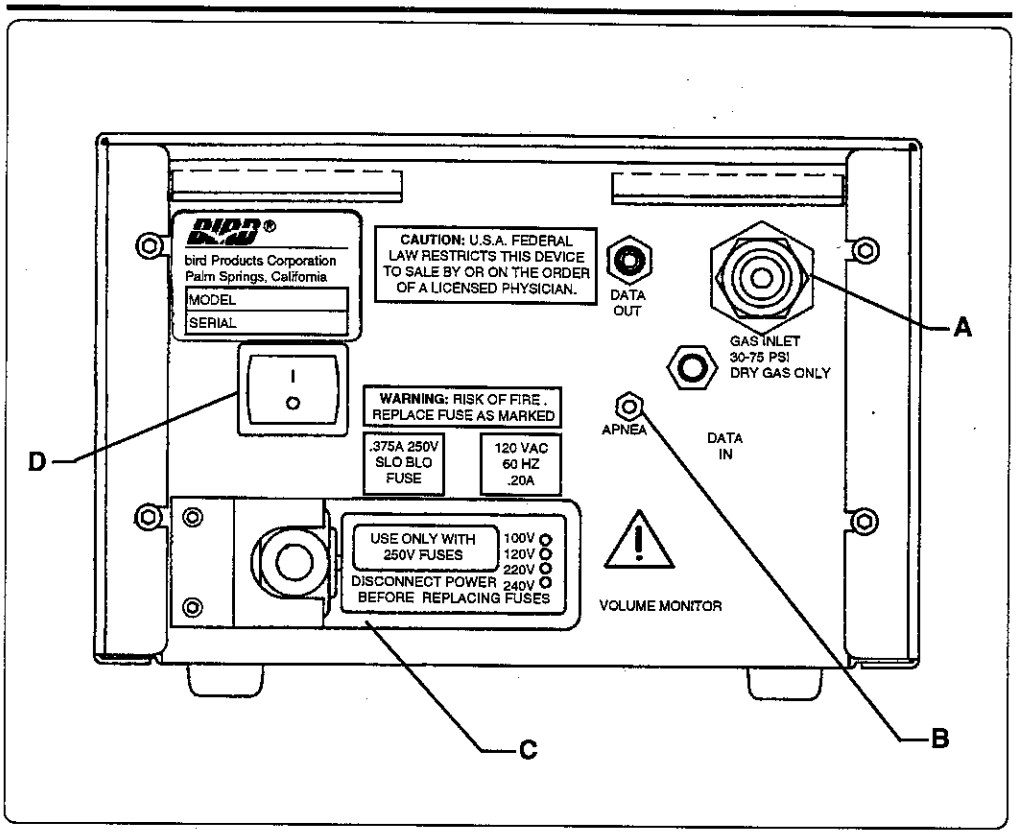
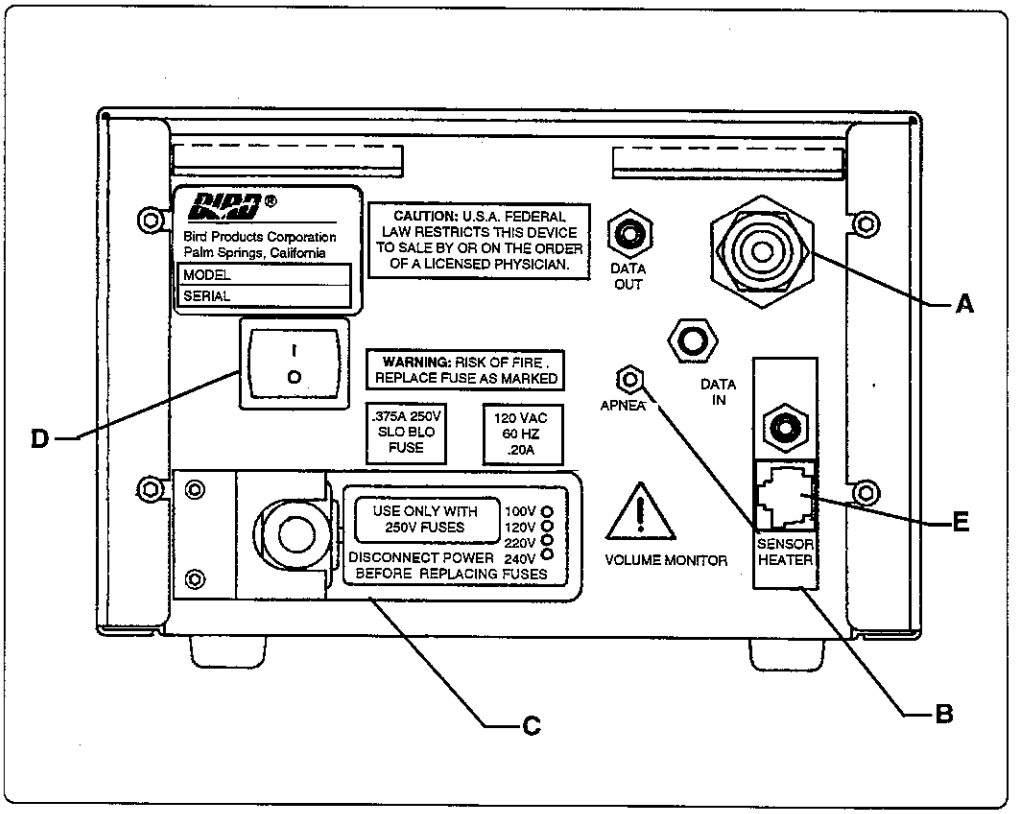


Figure 3.6
PARTNER IIi
Volume Monitor
Rear View



SECTION 3.0: OPERATING INSTRUCTIONS

3.2 DISPLAYS, INDICATORS, ALARMS AND CONTROLS

The following notes apply to this section. It is highly recommended that you read and understand this material before proceeding.

NOTES:

- Both the High Breath Rate Alarm and the Low Minute Volume Alarm incorporate audible and visual alarm indicators. The audible portion of the alarm can be silenced for 60 seconds by depression of the Silence/Reset button. After correction of the alarm condition, the visual portion of the alarm will continue until the Reset button is depressed.

- The Pediatric and Adult Flow Sensors are designed to be placed in the patient circuit just before the exhalation valve. When properly placed in the circuit, they receive flow only in the direction of the arrow on the sensor. PARTNER Volume Monitors manufactured prior to April 1993 have a button labeled INSP V_t which is inactive. In the PARTNER II*i*, the Insp. V_t button (Figure 3.4) is inactive if a Pediatric Sensor is installed. PARTNER Monitors manufactured after April 1993 have a button labeled TEST (Figure 3.3). This button is not active during normal monitor operation. This button accesses a diagnostic function that is intended to be used by service personnel only to verify current software revision levels in the monitor.

- The Infant Flow/Volume and Flow Trigger Sensors are designed for use between the patient circuit "wye" and the endotracheal tube. In this position, they are not affected by continuous flow and Continuous Flow Compensation is NOT required when using these sensors. When either Infant Sensor is installed in the base unit, the function of the Cont. V button is changed to display the real time flow signal from the infant sensor at the patient "wye".

3.2.1 Displays

Tidal Volume (ml) [redacted]	*TIDAL VOLUME:* Continuously displays the tidal volume in milliliters. This value is updated at the beginning of the next breath. Display Range: 0 to 9999 ml Resolution: Infant Flow/Volume Sensor 0.1 ml Adult and Pediatric Sensors 1.0 ml • The Infant Flow/Volume Sensor measures effective volume. • The Pediatric and Adult Sensors measure total exhaled volume, i.e. compressible volume loss plus effective volume.

Breath Rate (bpm) 	*BREATH RATE:* Continuously displays the total breath rate. This value is updated at the beginning of the next breath. Breath rate is calculated from an eight breath average as follows: • 8 Breaths/Sum Of Last 8 Breath Periods (Min) • This value is updated on a breath by breath basis Display Range: 0 to 999 BPM
Minute Volume (l) 	*MINUTE VOLUME:* Continuously displays the minute volume in liters. This value is updated at the beginning of the next breath. Minute volume is calculated from an eight (8) breath average as follows: (Total Breath Rate) X (Sum Of Last 8 Tidal Volumes (L) / 8) This value is updated on a breath by breath basis. Display Range: 0.0 to 99.9 L Resolution: Infant Flow/Volume Sensor 0.01 L Adult and Pediatric Sensors 0.1 L

3.2.2 Indicators

	*FLOW:* Amber LED indicates that flow has been detected. Minimum Detectable Flow: Infant Sensor 0.2 LPM Pediatric Sensor 2.0 LPM Adult Sensor 4.0 LPM When employing the Continuous Flow function for the Pediatric and Adult Sensors, the amber LED indicates detection of flow **above** the baseline continuous flow level.

SECTION 3.0: OPERATING INSTRUCTIONS

3.2.2 Indicators
Continued

Power	*POWER:* Green LED indicates that the ON/OFF switch is in the ON position and electrical power is being received by the unit. ON is indicated by the symbol "I" and OFF by the symbol "O".
Insp. V_t	*INSP. V_t:* **PARTNER II*i* Infant FlowVolume Sensor only** Green LED indicates that the Inspiratory Tidal Volume button has been depressed and that effective inspiratory volumes are being displayed when using an Infant Flow/Volume Aensor. Effective inspiratory tidal volumes will be displayed only while this button is depressed.
Cont. $\dot{V}$	*CONT. $\dot{V}$:* **Adult and Pediatric Sensors:** Green LED indicates that Continuous Flow Compensation has been activated. **Infant Trigger and Flow/Volume Sensors:** Green LED indicates that the real time flow signal display has been activated.

3.2.3 Alarms

High Breath Rate (bpm)	*HIGH BREATH RATE:* The High Breath Rate Alarm is activated if the total breath rate exceeds the alarm setting. Depression of the "Up Arrow" button below the display window increases the setting while depression of the "Down Arrow" button decreases the setting. Range: 0 to 999 BPM Silence: Yes Audible: Intermittent "BEEP" Visual: Flashing Digital Display

Low Minute Volume (l)

LOW MINUTE VOLUME:

The Low Minute Volume Alarm is activated if the total minute volume does not exceed the set value. Depression of the "Up Arrow" button below the display window increases the setting while depression of the "Down Arrow" button decreases the setting. This alarm has an "OFF" setting which will disable the audible and visual alert.

Range:

- Infant Flow/Volume Sensor, Adult and Pediatric: "OFF", 0.0 to 99.0 L

Silence: Yes
Audible: Intermittent "BEEP"
Visual: Flashing Digital Display

<u>*NOTE:*</u> For PARTNERS with software revision 95.17 and higher, the following format applies.

-

Setting	Display Format	Resolution
0.01–1.00	X.XX	0.01
1.1–99.9	XX.X	0.1

Silence Reset

SILENCE/RESET:

Depressing the Silence/Reset button will activate the 60 second silence interval, silence any active audible alarms and/or reset any flashing visual alarm indicators.

If the Silence/Reset button is depressed during an active alarm condition, the amber Silence LED will light throughout the silence interval of 60 seconds. Depressing the button when the Silence LED is lit will cancel the alarm silence period and reset the visual indicators for all alarms which are not currently active.

If the Silence/Reset button is depressed when there are no active alarms but visual indicator(s) for previously active alarms are flashing, the visual indicators will reset and the Silence LED will not light.

If the Silence/Reset button is depressed when there are no active alarms or flashing visual alarm indicators, the Silence LED will light and the 60 second silence period is activated.

If the Silence/Reset button is depressed when no sensor is installed or recognized, the audible alarm will be silenced permanently.

SECTION 3.0: OPERATING INSTRUCTIONS

Apnea

APNEA INTERVAL:

A momentary switch is located on the rear panel of the monitor (item #B in Figures 3.5 & 3.6) that sets the apnea time interval. Depressing this switch displays the current setting in the Tidal Volume display window as "AP XX", where XX is the set value in seconds. Repeatedly depressing this switch will increase the current value by five (5) seconds until the maximum value of 60 seconds, after which the display will revert to the minimum value of 10 seconds and the process will repeat. The desired value will remain displayed for approximately three (3) seconds and then revert to the Tidal Volume display. Should power to the monitor be interrupted in any way including a normal power down – power up sequence, the current Apnea interval setting will be retained.

The current Apnea interval will be displayed in the tidal volume window following power up. The user must press the Silence/Reset button to switch to normal mode of operation.

<u>NOTE:</u> Prior to software revision 95.17, the Apnea Interval is not displayed on power-up.

Range:

- 10 seconds to 60 seconds in 5 second increments

APNEA ALARM:

The Apnea Alarm activates whenever the set apnea interval is exceeded.

Silence: Yes
Audible: Intermittent "BEEP"
Visual: Flashing Red LED

Monitor Inop

MONITOR INOP:

The Monitor Inop Alarm activates under the following conditions:

1) power supply voltage is out of range
2) Power Up Self Test fault is detected, or
3) the power switch is changed from the "ON" (I) to the "OFF" (O) position;
4) Internal fault detected during operation.

Silence: Yes - If ON/OFF switch is in the "OFF" position
Audible: Continuous Tone
Visual: Flashing Red LED

Sensor

SENSOR:

The Sensor Alarm activates if the flow sensor is not properly installed in the monitor (PARTNER and PARTNER II*i*) or if power to the Infant Flow/Volume Sensor heating element is interrupted (PARTNER II*i* only).

Sensor not properly installed

Silence: Yes *(silent until corrective actionis taken)*
Duration: Until correct sensor is properly installed
Audible: Continuous Tone
Visual: Flashing Red LED, all displays dashed

Power to heating element interrupted

Silence: Yes
Duration: Until power is restored to the heating element
Audible: Intermittent "Beep"
Visual: Flashing Red LED, all displays remain active

3.2.4 Controls

Insp. V_t

INSP. V_t : PIIi / PVM – 4/2/93 OR EARLIER

When using the Infant Flow/Volume Sensor between the patient circuit "wye" and the endotracheal tube, depression of this button causes the microprocessor to ignore flow in the direction of the arrow on the sensor and to measure flow in the opposite direction. When the Infant Flow/Volume sensor is properly placed, with the arrow pointing toward the endotracheal tube, depression of this button results in the measurement of effective inspiratory volume. Effective inspiratory volume will be displayed as long as the Insp. V_t button is depressed. When the button is released, the display will return to displaying effective exhaled volume.

This feature is intended to allow for assessment of gas leaks around the endotracheal tube by allowing the clinician to compare the effective inspiratory volume with the effective exhaled volume.

SECTION 3.0: OPERATING INSTRUCTIONS

3.2.4 Controls
Continued

TEST: PARTNER (Only) – 4/2/93 Or Later

This button is not active during normal monitor operation. This button accesses a diagnostic function that is intended to be used by service personnel only.

CONTINUOUS FLOW (CONT. V̇):
Pediatric and Adult Sensors Only (PVM & PIIi)

Depression of the Cont. V̇ button will establish a "zero" flow level measurement to whatever level of continuous flow is passing through the sensor at the time the button is depressed. In effect, the volume monitor ignores any flow less than or equal to the "zero" level and measures any flow above the zero level. This function will be effective only when the Pediatric or Adult Flow Sensors are placed in the patient circuit between the distal end of the exhalation limb and the exhalation valve body with the arrow on the sensor pointing towards the exhalation valve. A green LED located above the button is illuminated when the function is active.

For accurate function, the button should be depressed only during the exhalation phase after the patient has completely exhaled. With high respiratory rates, it may be necessary to momentarily disconnect the patient and cap the "wye" so that an accurate reading of preset continuous flow rate can be obtained. When the button is depressed, the measured continuous flow is displayed for three seconds in the Breath Rate display as "F XX" where "XX" represents the flow in liters per minute. After three seconds the monitored Breath Rate will reappear and the green LED above the button will remain illuminated indicating that the function is active. If the continuous flow level is changed , this procedure must be repeated in order to monitor Tidal and Minute Volumes accurately.

<u>NOTE:</u> The following procedure applies to Monitors with software revision 92:21 or later.

To verify the measured continuous flow level, momentarily depress the Cont. V̇ button. "F XX" will appear for three seconds indicating the measured flow level. The green LED will remain illuminated indicating that the function is still active.

Cont. $\dot{V}$	To deactivate the function, or to reset to a new level of continuous flow, depress the button for two (2) seconds and verify that the green LED is no longer illuminated indicating that the function is no longer active. To reset, depress the button during the exhalation phase after complete exhalation.
	CONTINUOUS FLOW (CONT $\dot{V}$): ***INFANT FLOW/VOLUME SENSOR (PIIi)*** ***INFANT TRIGGER SENSOR (PVM)*** When an Infant Trigger or Flow/Volume Sensor is properly installed in the base unit, the function of the Cont. $\dot{V}$ button changes so that when activated the real time flow signal as measured at the sensor will be displayed in the Breath Rate display window. To activate this function, depress the Cont. $\dot{V}$ button. The green LED will illuminate indicating that the function is active. The real time flow signal will now be displayed in the Breath Rate window. Real time flow will be designated as "XX" where XX indicates the level of flow in liters per minute. To deactivate the function and return to Breath Rate monitoring, depress the Cont. $\dot{V}$ button and verify that the green LED is no longer illuminated.

3.3 EQUIPMENT SETUP

The following Warnings, Cautions and Notes apply to this section. It is highly recommended that you read and understand this material before proceeding.

WARNING !

- Although it does not affect sensor accuracy, placement of tubing between the Infant Trigger or Flow/Volume sensors and the endotracheal tube will increase the "deadspace" volume of the circuit. Care should be taken to ensure that adequate ventilation is maintained if tubing is placed between the endotracheal tube and the sensor.

CAUTIONS ✔

- ✔ To avoid damage to internal components, use only clean, dry medical grade gas as a purge gas source.
- ✔ Placement of sensors in areas other than described in Section 3.3 may result in inaccurate volume measurement and/or improper function of the CONT. $\dot{V}$ and/or INSP. V_t functions.

NOTE:

- The Pediatric and Adult Flow Sensors achieve their greatest accuracy when placed in the patient breathing circuit just before the exhalation valve with the arrow pointing in the direction of exhaled gas flow. These sensors have NOT been designed to be placed at the patient circuit wye. Doing so may result in inaccurate volume measurement.

3.3.1 Connection of Sensor to Base Unit

Choose the appropriate sensor type (Infant Trigger, Infant Flow/Volume, Pediatric or Adult) for the patient. Insert sensor connector into the base unit by matching the appropriate keyed slots. Turn the connector clockwise until the positioning mark on the sensor connector matches the positioning mark on the base unit sensor receptacle. The sensor has now been properly installed. If a sensor is rotated counterclockwise from the installed position, it must be completely removed from the base unit receptacle and reinserted before the base unit will recognize it as a proper sensor.

If installing an Infant Flow/Volume Sensor, it is also necessary to connect the telephone type plug into the "Sensor Heater" receptacle in the back panel of the PARTNER II*i* only. This connection supplies power to the heating element in the Infant Flow/Volume Sensor head assembly.

3.3.2 Attachment of Purge Gas Source to Base Unit

The PARTNER is designed to accept air/oxygen blended gas from the auxiliary 50 psi gas outlet on the side of the V.I.P. BIRD ventilator. The accessory hose provided with the unit is intended to be attached at the auxiliary gas port of the V.I.P. BIRD. The free DISS end of the accessory hose (P/N 10340) can be used to attach a flow meter or other gas delivery device.

WARNING !

- Purge gas for the PARTNER must be supplied from the auxiliary gas port on the V.I.P. BIRD to ensure that the purge gas is at the same air/O_2 mixture as that being delivered to the patient by the ventilator. Use of either pure air or oxygen as a purge gas source may result in improper FIO_2 delivered to the patient in the event of a purge solenoid leak.

3.3.3 Attaching the Fiber Optic Cable from PARTNER to the 6400ST®

When using the PARTNER with the 6400ST, it is necessary to attach a fiber optic data transmission cable (P/N 15091) between the two devices. Connect the non-threaded end of the cable to the 6400ST port (located on the rear panel) labeled "DATA LINK". Attach the other end of the cable to the PARTNER port (located on the rear panel) labeled "DATA IN". (Refer to Section 3.1.9 for a detailed description of this feature.)

3.3.4. Fiber Optic Link to V.I.P BIRD® Infant-Pediatric Ventilator

Theory of Operation

The fiber optic link transmits breath phase information from the V.I.P. BIRD to the PARTNER. This facilitates timing of the PARTNER pressure sensing line purge function. It also allows the PARTNER to measure exhaled volumes accurately with the V.I.P. BIRD in the time cycled mode and the flow control set to greater than 15 LPM (i.e. inspiratory flow greater than expiratory continuous flow).

3.3.4.1 Assembly

a. Place a piece of white paper up to the A and B data link ports on the rear of the V.I.P. BIRD. A red beam of light should emit from the B port (DATA OUT). If the red beam is emitting from the A port, this simply means that the transmit/receive cables are crossed internally. This should not cause any problem with the data link to the PARTNER.

b. Connect a fiber optic cable between the V.I.P. BIRD B port (or A port if the beam originates from here) and the DATA IN port on the PARTNER. This completes the fiber optic link between the ventilator and the monitor.

SECTION 3.0: OPERATING INSTRUCTIONS

WARNING !

- **Do not** connect a fiber optic cable between the DATA OUT on a V.I.P. BIRD Ventilator and the DATA IN port on a PARTNER Monitor which has software revision 92:21 or earlier. If connected, the PARTNER Monitor will detect flow, i.e Flow LED will illuminate, however, the Tidal Volume, Breath Rate and Minute Volume displays will read zero and the Low Minute Volume alarm will activate.

NOTE: The fiber optic link function, associated with PARTNER Monitors with software revision 92:21 or later, is compatible with any V.I.P. BIRD Ventilator regardless of the ventilator's software revision (A, B, and C EPROMS)

3.3.5 Placing the Sensor in the Patient Breathing Circuit

3.3.5.1 Infant Sensors - The Infant Trigger and Flow/Volume Sensors have been designed to be placed between the patient circuit wye and the endotracheal tube with the arrow on the sensor pointing in the direction of the patient. The Infant Flow/Volume Sensor measures tidal volume.

3.3.5.2 Pediatric and Adult Sensors - The Pediatric and Adult Sensors have been designed to be placed in the expiratory leg of the patient circuit between the exhalation valve and the patient circuit with the arrow on the sensor pointing in the direction of exhaled gas flow. These sensors measure total exhaled volume, i.e. compressible volume loss plus effective volume.

Placement of these sensors in areas other than described above may result in inaccurate volume measurement and/or improper function of the Cont. $\dot{V}$ and/or INSP. V_t functions.

3.3.6 Power

Connect the power cord to an appropriate electrical outlet.

3.4 OPERATION

The following Warning and Notes apply to this section. It is highly recommended that you read and understand this material before proceeding.

WARNING !

- If it is necessary to disconnect the patient circuit from the endotracheal tube in order to activate the Cont. $\dot{V}$ feature, ensure the patient receives adequate ventilation by alternative means, such as a hand resuscitation device.

NOTES:

- The Cont. $\dot{V}$ button activates Continuous Flow Compensation with the Pediatric and Adult Sensors for use during continuous flow. If the Infant Sensor is installed, the function of the Cont. $\dot{V}$ button changes to display the real time flow signal as measured at the sensor.

- Whenever the level of continuous flow is changed, it is necessary to "zero" the monitor to the new level of continuous flow using the Cont. $\dot{V}$ button. Otherwise, inaccurate volume measurement will occur. (Pediatric and Adult Flow Sensors only.)

- The Insp. V_t button is active and may be used only if there is an Infant Flow/Volume Sensor attached to a PARTNER II*i* Volume Monitor, and then, only when the Infant Flow/Volume Sensor is placed between the patient "wye" and the endotracheal tube with the arrow on the sensor facing toward the patient.

Follow the set up procedure described in Section 3.3. Turn the power switch located on the back of the unit to the ON (I) position (refer to item #D in Figures 3.1 & 3.2).

3.4.1 Solenoid Leak Test

This allows the user to test the purge manifold system in the PARTNER base unit for leaks. Bird Products recommends that this test be performed with every new patient set up.

NOTES:

- This test may be interrupted at any time by powering down of the PARTNER Monitor.

- Medical gas grade (50 psi) must be connected to the rear of the PARTNER base unit before performing this test.

Step	Reason
1) Verify that an acceptable flow sensor is correctly installed in the PARTNER base unit and turn the PARTNER Monitor OFF. Sensor **must not** be attached to test lung or patient circuit.	
2) Power-up the PARTNER Monitor.	
3) Depress the "INSP V_t" or "TEST" button when the LED displays begin to rotate.	This places the PARTNER in the U.V.T. (User Verification Test mode).
4) Read the 4 digit number in "Tidal Volume" display.	This is the software Revision Level present in the PARTNER Unit.
5) Read the "Breath Rate" display to verify that the number displayed is 1.	
6) Depress the "CONT $\dot{V}$" button one time.	This will activate the solenoid leak test.
7) Verify that the test name appears in the Breath Rate and Minute Volume displays as "SoL ChE".	If the sensor is not properly installed, then the message "nEEd SEn SOr" will appear in the Tidal Volume, Breath Rate and Minute Volume displays.
8) Verify that the Tidal Volume display indicates "PASS".	Indicates the solenoid passes the leak test.
9) If the Tidal Volume window display indicates "FAIL", contact your Bird Products Service Representative.	This indicates that the solenoid failed the leak test and requires service.

3.4.2 Sensor Placement

Check to ensure that the flow sensor has been placed in the recommended position with the arrow on the sensor pointing towards the direction of exhaled gas flow (or toward the patient if using the Infant Flow/Volume Sensor, refer to Section 3.3.5.)

3.4.3 Monitored Values Windows

Observe the values displayed in the Tidal Volume, Breath Rate, and Minute Volume display windows. These values will be continuously displayed during normal operation.

NOTE: If using the Infant Trigger Sensor (P/N 10175R), Tidal Volume and Minute Volume will display "---" indicating that these valves are not being monitored.

3.4.4 Alarm Settings

High Breath Rate - Observe the value displayed in the Breath Rate window. Verify alarm function by setting the alarm at or below the monitored value for Breath Rate. Once the alarm has activated, set to an appropriate value by depressing either the Up Arrow button or the Down Arrow button. Depress the Silence/Reset button to reset the alarm visual indicator.

Violation of this alarm setting will activate an audible alarm (intermittent "BEEP") and visual alarm (flashing High Breath Rate Alarm setting display).

Low Minute Volume - Observe the value displayed in the Low Minute Volume window. Verify alarm function by setting the alarm at or above the monitored value for Minute Volume. Once the alarm has activated, set to an appropriate value by depressing either the Up Arrow button or the Down Arrow button. Depress the Silence/Reset button to reset the alarm visual indicator.

When using the Infant Flow/Volume Sensor, clinical conditions may exist which cause the monitored Minute Volume value to be less than the minimum Low Minute Volume Alarm setting of 0.1 L. This will cause continual activation of the alarm. If this is the case, the Low Minute Volume alarm setting may be set to "OFF". This position can be set by depressing the Down Arrow button until the alarm display stops at "OFF". This display will flash continuously to remind the user that this alarm has been disabled. The "OFF" setting is not available when using either the Adult or Pediatric Sensors. It is important to note that in this position the Low Minute Volume alarm will no longer be an active alarm function.

Violation of this alarm setting will activate an audible alarm (intermittent "BEEP") and visual alarm (flashing Low Minute Volume Alarm setting display).

Apnea Interval - Depress the Apnea Interval switch on the rear panel to display the current setting. This setting will be displayed in the Tidal Volume display window (as "AP XX", where XX represents the setting in seconds) when the switch is activated. Adjust the setting to an appropriate value by repeatedly depressing the switch until the desired setting is obtained. This setting will be displayed for approximately three (3) seconds and then revert to the Tidal Volume display.

3.4.5 Silence/Reset Button Operation

Depressing the Silence/Reset button will activate the 60 second silence interval, silence any active alarms and/or reset any flashing visual alarm indicators.

If the button is depressed during an active alarm condition, the amber Silence LED will light throughout the silence interval of 60 seconds. Depressing the button when the Silence LED is lit will cancel the alarm silence period and reset all alarms.

If the Silence/Reset button is depressed when there are no active alarms but visual indicator(s) for previously active alarms are flashing, the visual indicator(s) will reset and the Silence LED will not light.

If the Silence/Reset button is depressed when there are no active alarms or flashing visual alarm indicators, the Silence LED will light and the 60 second silence period is activated.

3.4.6 Insp. V_t Button Operation

When using the Infant Flow/Volume Sensor (PII*i* only) as described in Section 3.2, depressing and holding the Insp. V_t button will light the green Insp. V_t LED and display effective inspiratory volumes in the Tidal Volume display window. (Refer to Section 3.1.6 for a detailed description of this function.)

3.4.7 Cont. $\dot{V}$ Button Operation

NOTES:

- The Cont. $\dot{V}$ button activates Continuous Flow Compensation with the Pediatric and Adult Sensors for use during continuous flow. If the Infant Sensor is installed, the function of the Cont. $\dot{V}$ button changes to display the real time flow signal as measured at the sensor.

- Check to ensure that the desired level of continuous flow is being achieved. Make any necessary adjustments to the level of flow. Remove the patient circuit from the endotracheal tube or tracheostomy tube and occlude the patient "wye" so all continuous flow passes through the flow sensor.

WARNING !

- If it is necessary to disconnect the patient circuit from the endotrachael tube in order to activate the Cont. $\dot{V}$ feature, ensure the patient receives adequate ventilation by alternative means, such as a hand resuscitation device.

When the desired level of continuous flow is achieved, depressing the Cont. $\dot{V}$ button lights the green Cont. $\dot{V}$ LED and "zero's" the monitor to that level of continuous flow. The level of continuous flow measured is displayed for three (3) seconds in the Breath Rate display window (as "F XX", where XX represents flow in lpm). The monitor will now measure all flow greater than the level of continuous flow and display it as exhaled Tidal Volume. (Refer to Section 3.2 for a detailed description of this function.)

NOTE: Depressing the Cont. $\dot{V}$ button during an active machine cycled breath will not allow for a stable baseline flow for "zero calibration".

To verify that the PARTNER is compensating for the correct amount of continuous flow, momentarily depress the Cont. $\dot{V}$ button. The current level of continuous flow being compensated for will be displayed in the Breath Rate window for three seconds after which the display will return to Breath Rate monitoring.

If the level of continuous flow is changed, the monitor will again have to be compensated for the new level of continuous flow. To do this, press the Cont. $\dot{V}$ button for two (2) seconds to deactivate this feature. Reset the continuous flow feature as described in the above procedure.

3.5 CLEANING & STERILIZATION

The following Warning and Cautions apply to this section. It is highly recommended that you read and understand this material before proceeding.

WARNING !

- All infant flow sensors are designed and manufactured to accurately and repeatably measure flow. Extended usage, failure to thoroughly clean the sensor, and exposure to harsh environments such as moisture, chemicals, and sterilization can, however, degrade the performance of the device over time. The warranty period for flow sensors is ninety (90) days from the date of purchase.

CAUTIONS ✔

- ✔ **Do not** insert cleaning instruments (brushes, pipe cleaners, etc.) into the flow sensor or direct gas under high pressure into the flow sensor. Damage to the flow element could result and cause inaccurate volume measurement.
- ✔ **Do not** spray cleaning solutions directly on the Base Unit. Wipe base unit with a cloth moistened with an appropriate cleaning solution.
- ✔ **Do not** sterilize the Infant Flow/Volume or Infant Trigger Sensors by pasteurization or steam autoclave. The material used in the flow element is not compatible with temperatures in excess of 150°F. Exposure to temperatures above this level may result in damage to the sensor.
- ✔ Each sensor assembly (flow sensor, pressure tubing and connector) is manufactured to remain together as a single piece. Disconnection of any of the component parts of the assembly could severely affect the sensor's accuracy.
- ✔ When using a liquid sterilization process on the flow sensor assembly, ensure that the pressure sensing lines are ***completely*** dry before returning the sensor to use. Failure to do so will result in inaccurate volume measurement and/or a "Monitor Inop" condition.
- ✔ The operator should routinely inspect the two rubber O-rings located in the sensor receptacle on the base unit (refer to Figure 4.1 on page 4-1). If these O-rings are missing or damaged they must be replaced before the monitor is returned to service.
- ✔ **Do not** autoclave the monitor base unit. **Do not** sterilize the base unit by gas or liquid techniques. **Do not** expose the base unit to temperatures in excess of 158° F (70° C).

3.5.1 Infant Flow/Volume Sensors:

Infant Flow/Volume Sensors should be cleaned at least once every 24 hours in order to maintain accurate volume monitoring and triggering capabilities.

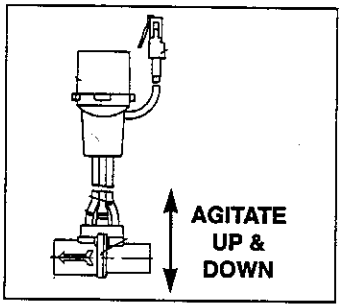
CLEANING: The heated infant flow sensor may be cleaned by immersion in an enzymatic cleaner. Ultrasonic cleaning is not recommended.

STERILIZATION: The heated infant flow sensor may be sterilized by exposure to ETO. Cold liquid sterilizing agents may be used provided that all residues of the sterilizing agent are removed from the sensor flow element. Minimal immersion times should be employed when sterilizing with cold liquid sterilizing agents.

Immersion Cleaning: Prepare a warm solution (<100°F) of the enzymatic cleaning agent per the manufacturer's instructions.

1. Immerse the sensor(s) to be cleaned in the tank and allow to **soak for 10 minutes.** Periodic up and down agitation may assist the cleaning process (refer to Figure 3.7).

Figure 3.7



NOTE: Do not agitate side to side (refer to Figure 3.7). This could cause the flow element to adhere to the sensor wall.

2. Remove the sensor(s) from the cleaning solution and immediately place in warm (<100°F) sterile (distilled/de-ionized) water. **Agitate up and down to ensure a complete rinse (refer to Figure 3.7).**

3. Remove the cleaned sensor(s) from the rinse tank and prepare for sterilization.

Sterilization Preparation:

1. If the sensor is to be sterilized in a cold sterilizing agent, it should be placed in the sterilizing agent immediately after the warm water rinse.

2. If the sensor is to be sent for ETO sterilization, allow the sensor(s) to dry thoroughly. When dry, visually inspect the sensor for foreign material, particularly the flow element. If the sensor flow element is clean there should be no apparent residue. If residue is apparent, repeat the cleaning process. If the flow element is not visible it may have adhered to the wall of the housing (typically the case when not visible). The flow element may be freed by re-immersing the sensor in warm (<100°F) water for approximately 15 minutes. *Repeat the rinsing process.*

NOTE: The use of a low flow (< 5 lpm) gas source placed in the gray receptacle (PARTNER® II*i* end) can facilitate the drying of the sensor pressure lines.

Cold Liquid Sterilization:

1. Allow the cleaned sensor(s) to soak in the sterilizing agent. Do not exceed the length of time recommended by the manufacturer.

2. Remove the sensor(s) from the sterlizing liquid and immediately rinse in warm (<100°F) sterile (distilled/de-ionized) water.

   Agitate up and down to ensure a complete rinse.

3. Following the rinse allow the sensor(s) to dry thoroughly. After drying, visually inspect the sensor for foreign material, particularly the flow element. If the sensor flow element is clean there should be no apparant residue. If residue is apparent, repeat the cleaning process. If the flow element is not visible it may have adhered to the wall of the housing (typically the case when not visible). The flow element may be freed by re-immersing the sensor(s) in warm (<100°F) water for approximately 15 minutes. *Repeat the rinsing process.*

ETO Sterilization: After drying and visual inspection, the sensor(s) may be sent for ETO sterilization.

CHECKOUT: Upon completion of cleaning and sterilization, perform the PARTNER® II*i* flow sensor "Field Verification Test". If the sensor does not pass the Field Verification Test, repeat the cleaning process and retest.

3.5.2 Field Verification Test

Bird Products Corporation recommends that a system checkout test be performed before placing the V.I.P. BIRD® system into service. The purpose of the test is to verify that the flow volume sensors and the PARTNER® II*i* base unit are operating within the specified limits.

Perform the PARTNER® II*i* Field Verification Test per the following instructions:

Equipment and Material Requirements:

Part Number(s)	Description
15420	Flow Sensor to be tested
15285	PARTNER® II*i* Volume Monitor (calibrated)
15215, 10271	V.I.P. BIRD® Infant-Pediatric Ventilator
10383	Infant Flow/Volume Test Apparatus

Test Set Up: Set up test equipment **per Figure 3.8** as shown on page 3-28.

Provide electrical and gas supplies toV.I.P. BIRD® as described in the V.I.P. Bird Instruction Manual (P/N L1194) and to the PARTNER® II*i* as described in Section 3.3.2 on page 3-16.

Leak Test: The ventilator power ON/OFF (I/O) switch must first be in the OFF (O) position.

While pressing the Select button, turn the power switch to the ON (I) position. Continue to press the Select button until the display reads **"226"**. At this time, discontinue pressing the Select button. The following message will appear in the monitor display window:

CAUTION: REMOVE PATIENT PRESS SELECT:

Adjust the High Pressure Limit to the maximum setting (80 cmH_2O in TCPL, 120 cmH_2O in volume mode). Then continue to press the Select button until the following is continually displayed in the monitor window:

"PRSR TEST BLOCK PATIENT WYE PRESS SELECT"

Press the Select button. After the test, **"PRS PASS"** should be displayed. Press the Select button again. **"LEAK PASS"** should be displayed in the monitor window. If both tests passed, press the Select button to return the ventilator to normal operation and continue the Field Verification Test.

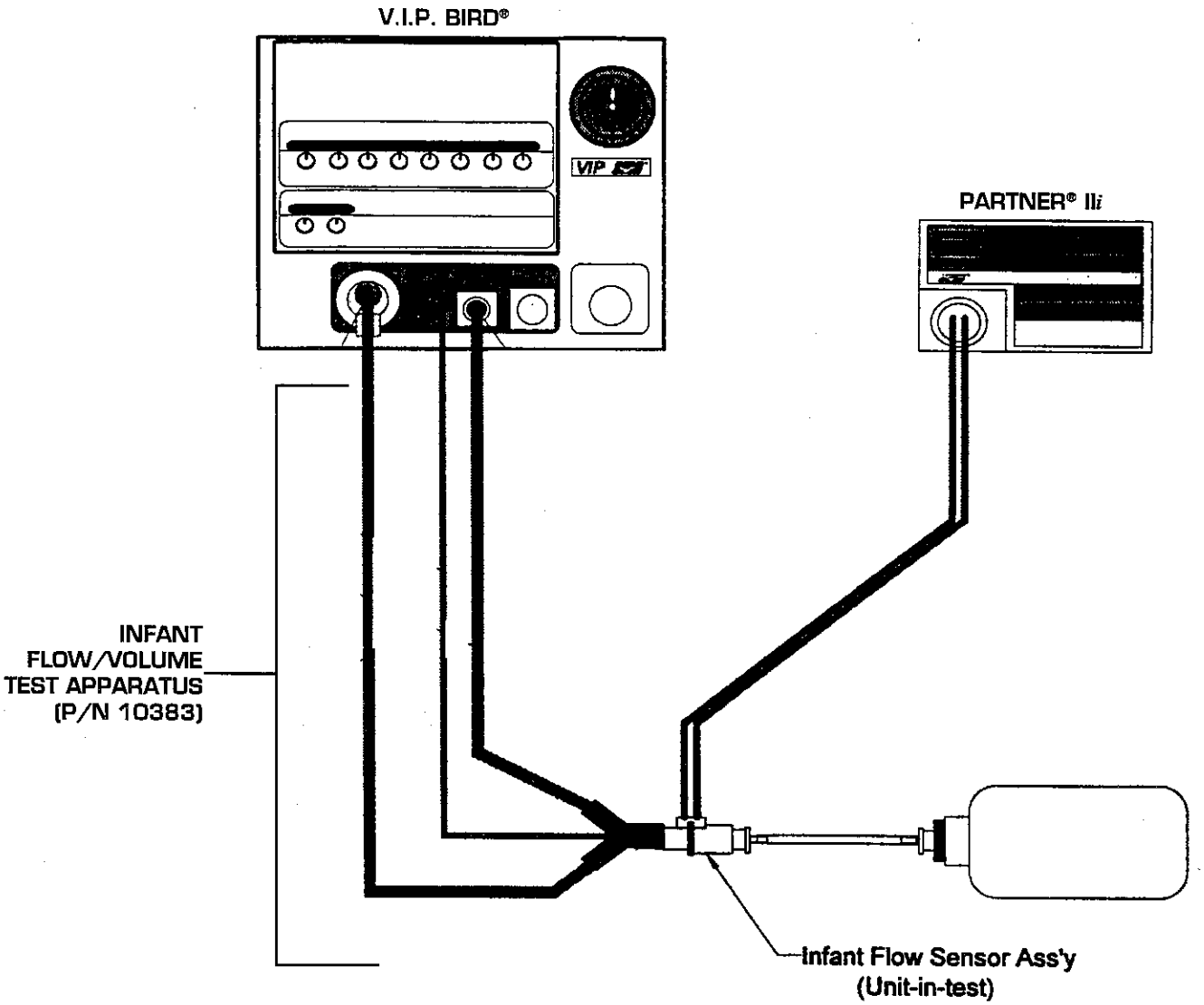
If either **"PRS FAIL"** or **"LEAK FAIL"** is observed, then the source of the failure must be determined prior to continuing the Field Verification Test. Refer to the Troubleshooting Guide on page 3-29.

Volume Ventilation: Turn the PARTNER® II*i* Volume Monitor power ON/OFF (I/O) switch to the ON (I) position. Adjust the ventilator and monitor controls as follows:

V.I.P. BIRD	
Control	**Set Point**
Mode	= SIMV (TCPL)
Insp. Time	= 1.00 sec
Breath Rate	= 10 BPM
Peak Flow	= 4 LPM
High Press. Limit	= 30 cmH_2O
PEEP	= 0
Assist. Sens.	= OFF
Press. Support	= OFF
Mech. Pop Off	= Max clockwise

PARTNER II*i*	
Control	**Set Point**
High Breath Rate	= 150 BPM
Low Minute Volume	= 0.0 liters

Figure 3.8 FIELD VERIFICATION TEST SET UP



Section 3.5.2: Field Verification Test
Continued

To perform the test, select the PIP display on the ventilator monitor and adjust the Pressure Limit control to obtain a reading of 30 cmH_2O PIP as displayed in the monitor window. Allow three (3) to five (5) breaths for the system to stabilize then observe and record the Tidal Volume (expiratory) displayed by the PARTNER® II*i*.

Using the chart below, the Tidal Volume reading on the PARTNER® II*i* should correspond with range provided for your altitude.

Altitude (ft.)	Display Range (ml)
Sea Level	26.3 to 34.8
1000	27.2 to 36.1
2000	28.2 to 37.4
3000	29.3 to 38.8
4000	30.4 to 40.3
5000	31.6 to 41.8
6000	32.8 to 43.4
7000	34.0 to 45.1

Should the sensor fail this test, refer to the following Troubleshooting Guide.

Troubleshooting Guide:

Problem	Potential Cause	Corrective Action
Field Verification Leak Test/ Pressure Test Fail	1) Defective sensor.	1) Remove sensor from circuit and re-run Leak Test: a) If test passes, replace with new sensor; or b) If test fails, go to Potential Cause #2.
	2) Defective exhalation valve body or diaphragm.	1) Replace diaphragm and re-test. 2) Replace exhalation valve housing and re-test. 3) See Potential Cause #3.
	3) Defective test apparatus.	1) Ensure that the test lung lid and all circuit connections are firmly in place. Re-test. 2) Replace test apparatus. 3) See Potential Cause #4.
	4) Defective over-pressure relief valve.	1) Contact Bird Products Technical Support at (800) 328-4139.
	5) V.I.P. BIRD/ PARTNER II*i* system.	1) Contact Bird Products Technical Support at (800) 328-4139.
Field Verification Volume Test Fail	1) Unclean sensor.	1) Repeat cleaning procedure and re-test.
	2) Defective sensor.	1) Replace sensor.
	3) Non specified test apparatus	1) Use Bird Test Apparatus (P/N 10383)
	4) Defective system.	1) Contact Bird Products Technical Service at (800) 328-4139.

3.5.3 Pediatric and Adult Sensors:

The sensor assembly can be sterilized by cold solution soak with a quaternary ammonium compound, pasteurmatic, steam autoclave, or ethylene oxide gas sterilization. Pressure sensing lines may be cleared of liquid by passing a **low flow** (<10 LPM) of gas through the lines. Pressure sensing lines must be **completely clear** of all liquid before returning sensor to use.

3.5.4 Base Unit

The base unit can be cleaned with a cloth moistened in a mild liquid detergent. **Do not** spray cleaning solutions directly on the base unit.

3.6 OPERATOR MAINTENANCE

3.6.1 Sensor Assembly

Regularly inspect all plastic components and tubing for cracks or tears. If plastic components or tubing exhibit cracks or tears, discontinue use of the sensor assembly.

Regularly inspect the flow element for tears or deformation. If the flow element appears to be torn or deformed, discontinue use of the sensor assembly.

3.6.2 Sensor Receptacle (item #A in Figures 3.3 & 3.4)

Regularly inspect the two O-Rings located inside the sensor receptacle (refer to item #B in Figures 3.3 & 3.4). If the O-Rings appear cracked or worn, replace with P/N 20191 (center O-Ring) and/or P/N 20192 (outer O-Ring).

All other maintenance procedures should be performed by an authorized Bird trained service technician.

3.7 TROUBLESHOOTING GUIDE

Symptoms	Recommended Action
1. Power switch is turned to the "on" position but monitor does not "power up".	a) Check to ensure that the monitor is plugged into the recommended power outlet. b) Check fuse.
2. Sensor alarm is active.	a) Check to ensure that sensor is properly connected to the base unit. b) Check to ensure that heating system plug is properly connected to the back of the base unit (PII*i* w/Infant Flow/Volume Sensor only). c) If Sensor heating system fault is suspected, turn off PARTNER II*i* Monitor and restart.
3. Inspiratory Tidal Volume function is activated but displayed value is zero. (PII*i* Only)	a) Verify that Infant Flow/ Volume Sensor is in use. b) Verify that Infant Flow/ Volume Sensor is placed in the recommended position (refer to Section 3.3.5).

Symptoms	Recommended Action
4. Monitored values are consistently lower (<5%) than ventilator set volume when using Pediatric or Adult flow sensors. Monitored values are consistently lower (<10%) than ventilator set volume when using Infant Flow/ Volume sensor	a) Confirm delivery of set ventilator tidal volume by a method approved at your hospital. b) Check that purge gas source is connected as recommended (refer to Section 3.3.2). c) Check for leaks in the patient circuit and correct if necessary. d) Check for water migration in one or both lines of the sensor tubing. If water migration is noted, replace sensor assembly. Should water migration persist, discontinue use of the monitor and have it repaired by a Bird trained service technician. e) Check to ensure that two (2) rubber O-rings are in place in the sensor receptacle on the base unit and that they are in good condition.

Symptoms	Recommended Action
5. Monitored values are consistently higher(>5%) than ventilator set volume when using Pediatric or Adult flow sensors. Monitored values are consistently higher (>10%) than ventilator set volume when using Infant Flow/ Volume sensor.	**a)** Confirm delivery of set ventilator tidal volume by a method approved at your hospital. **b)** Check that purge gas source is connected as recommended (refer to Section 3.3.6). **c)** Check for water migration in one or both lines of the sensor tubing. If water migration is noted, replace sensor assembly. Should water migration persist, discontinue use of the monitor and have it repaired by a Bird trained service technician. **d)** Check to ensure that two (2) rubber O-rings are in place in the sensor receptacle on the base unit and that they are in good condition.
6. Sensor is properly installed but monitor displays (Tidal Volume, Breath Rate and Minute Volume) read 0.	**a)** Check to ensure that two (2) rubber O-rings are in place in the sensor receptacle on the base unit and that they are in good condition.

Section 4.0

Maintenance & Service

PARTNER® & PARTNER® II*i* Volume Monitors
Instruction & Service Manual

SECTION 4.0: MAINTENANCE AND SERVICE

4.1 INTRODUCTION

This section is specifically intended for use by an authorized service person; that is, a person who has attended a service seminar conducted or authorized by Bird Products Corporation. Any repairs, adjustments or procedures that exceed the scope of this manual should be referred to the Bird Product Corporation Technical Service Center.

Service personnel should become thoroughly familiar with the operating and maintenance procedures before attempting service on this equipment. The WARNINGS and CAUTIONS section of the manual should be thoroughly read and understood before proceeding.

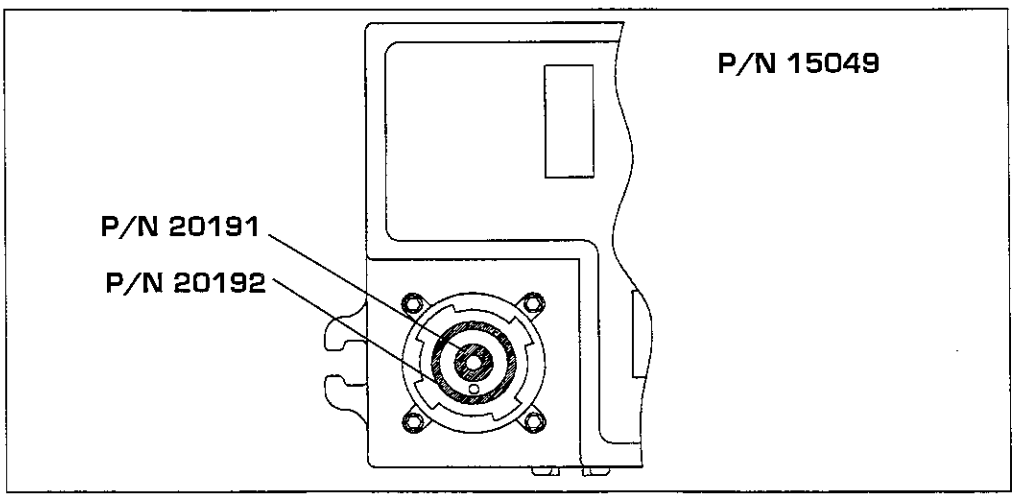
4.2 DISASSEMBLY / REASSEMBLY

The step-by-step instructions in this section are given as disassembly. In most instances, assembly can be accomplished by reversing the steps. Where assembly is not a simple reversal of disassembly, the difference is pointed out. It will not be necessary to do certain disassembly steps in order to get to the part you need to service, these are indicated as *OPTIONAL*.

4.2.1 Remove the flow sensor assembly by turning counterclockwise.

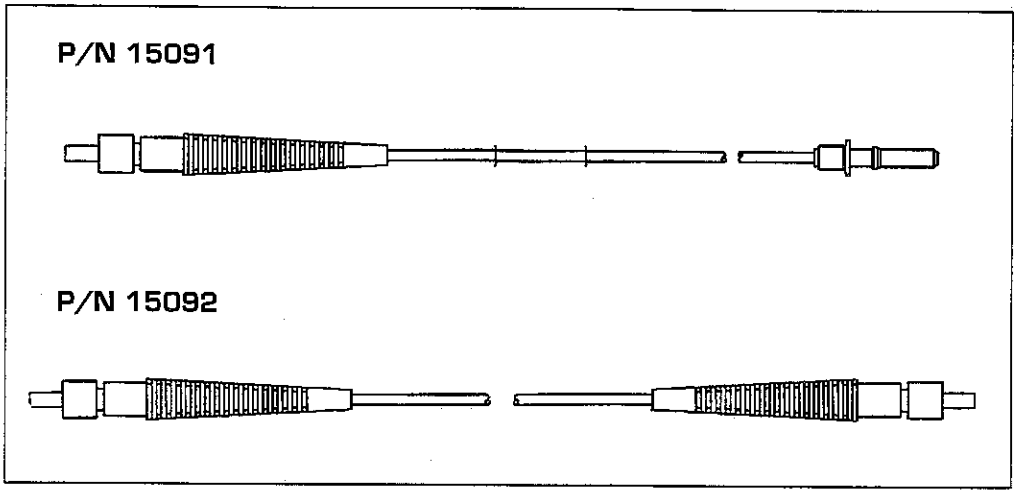
4.2.1.1 *Optional.* Use a pointed tool to remove the sensor receptacle O-rings (P/N 20191, inner; P/N 20192, outer). Install new O-rings by pressing them into the O-ring grooves. (Refer to Figure 4.1.)

Figure 4.1 RECEPTACLE



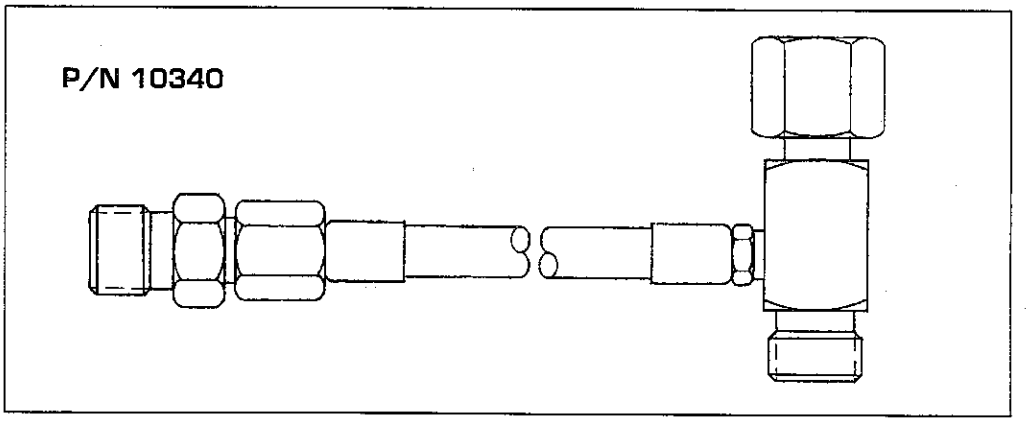
4.2.2 Remove the fiber optic cable(s) (P/N 15092, V.I.P.; P/N 15091, 6400ST). These should be reassembled only finger tight. (Refer to Figure 4.2.)

Figure 4.2 FIBER OPTIC CABLES



4.2.3 Remove the purge gas supply hose (P/N 10340). (Refer to Figure 4.3.)

Figure 4.3 PURGE GAS HOSE ASSEMBLY



4.2.4 Remove the PARTNER from its mounting bracket.

4.2.5 Unplug the power cord from the wall outlet.

4.2.6 *Optional.* Remove the two (2) screws (P/N 03226) securing the power cord retainer using a 3/32" Allen wrench; remove the retainer (P/N 20241).

4.2.7 *Optional.* Remove the power cord (P/N 09184, 110V; P/N 09185, 220V).

4.2.7.1 If the power fuse or power selector PCBA does not need service or has been serviced, go to 4.2.8.

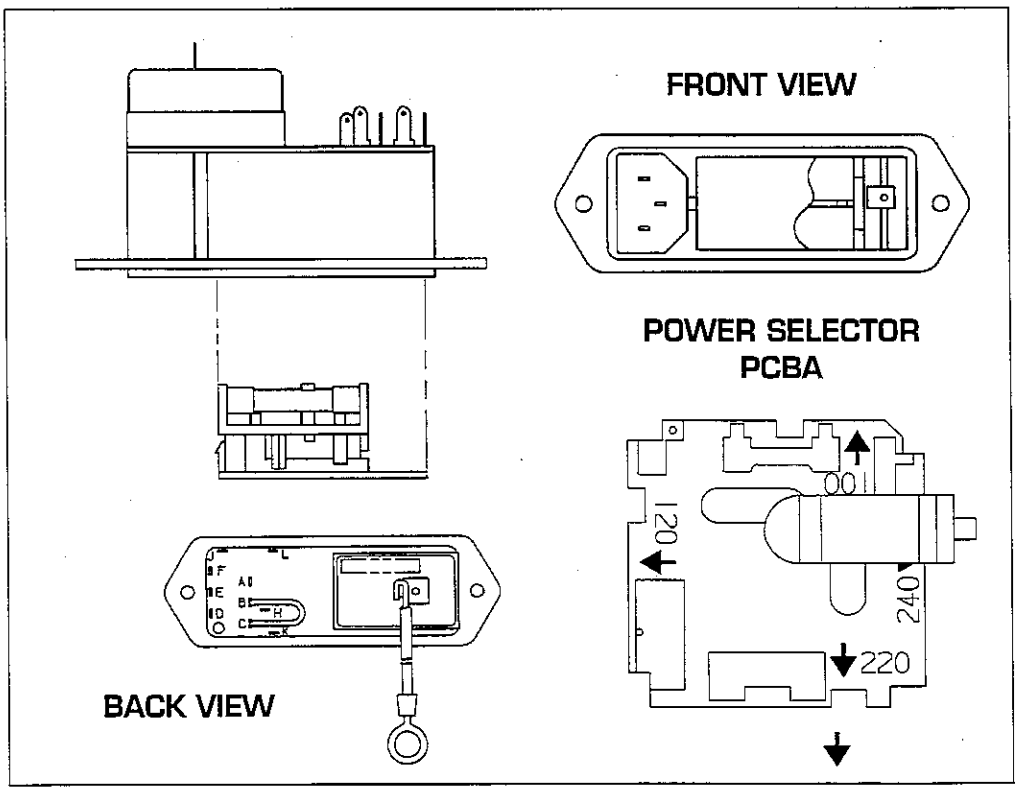
4.2.7.2 *Optional.* Use a small screwdriver to pry off the cover on the power entry module. (Refer to Figure 4.4.) To assemble snap the cover back in place.

4.2.7.3 *Optional.* Pry the fuse out of the fuse holder. To assemble, snap the fuse back into place. (Refer to the table below and Figure 4.4.)

P/N	Fuse	Selected Voltage
71523	3/8A	120V
71529	100mA	220V
71536	200mA	100V (Japanese)

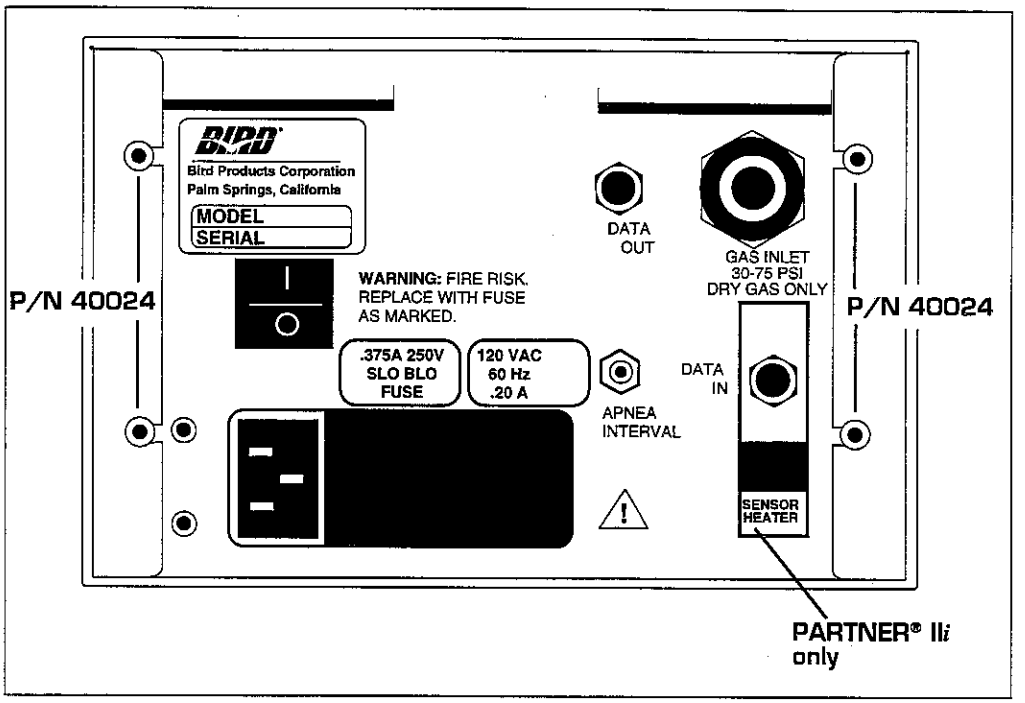
4.2.7.4 *Optional.* Look closely at the plastic piece on the power selector in the power entry module, notice that it has a small raised dot in its center. This appears as an indicator of the selected voltage on the cover of the power module. Also notice that it has an embossed arrow which points to one of four arrows on the left side of the compartment into which it fits. Make a note of the voltage selected prior to removing the power selector PCBA. (Refer to Figure 4.4.) Use needle nose pliers to pull the small power selector PCBA out of the compartment.

Figure 4.4 POWER ENTRY MODULE



4.2.8 Lay the PARTNER on its front panel, exposing the rear panel. Use a 5/64" Allen wrench to remove the four (4) screws (P/N 40024) along the side of the rear panel. (Refer to Figure 4.5.) Slide the top cover (P/N 20212) up and away from the base.

Figure 4.5 REAR PANEL ASSEMBLY



4.2.9 Use a 1/8" Allen wrench to remove the two (2) screws (P/N 40022) securing the front panel to the bottom plate. (Refer to Figure 4.6.)

4.2.10 Set the PARTNER back in the upright position so that you are facing the side with all of the tubing.

4.2.11 Unscrew the fiber optic cable from the bulkhead panel connector labeled DATA OUT. To assemble, screw the cable onto the connector finger tight. (Refer to Figure 4.2.)

4.2.12 Use masking tape or small tags to label the upper tubes (T1, T2) connected to the pressure transducer. (Refer to Figure 4.7.)

4.2.13 In the same fashion mark the lower tubes (P1, P2) connected to the sensor receptacle. (Refer to Figure 4.7.)

4.2.14 Pull straight back on each of the tubes to remove them from their ports. (Refer to Figure 4.7.)

Figure 4.6 **BOTTOM PLATE**

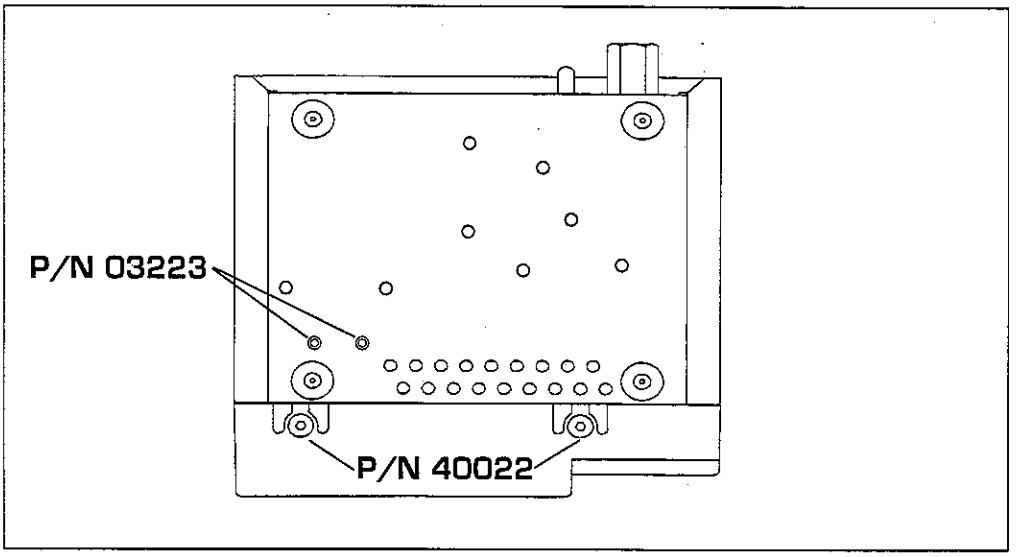
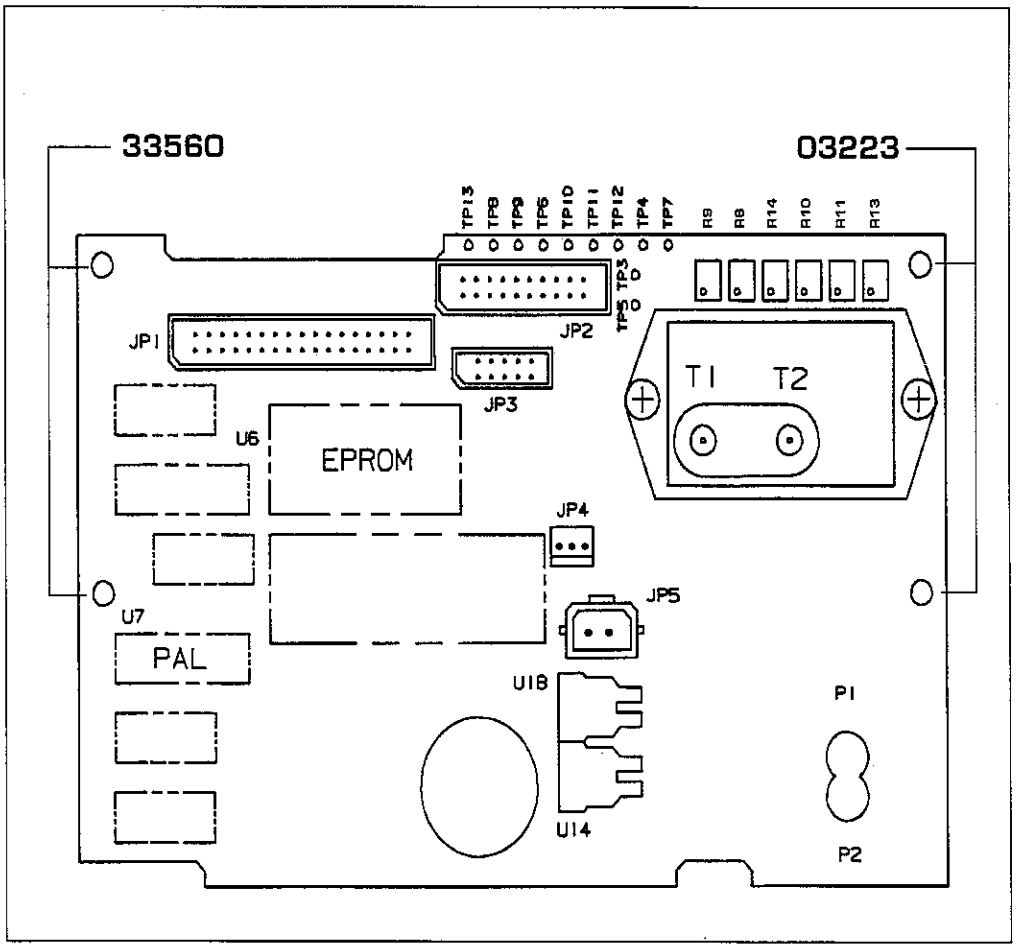


Figure 4.7 **MAIN PCBA**



4.2.15 Turn the PARTNER around so that you are facing the Power PCBA.

4.2.16 Remove the two (2) screws (P/N 03223) from the bracket attached to the Main PCBA with a 7/64" Allen wrench and slide the front panel away from the base plate approximately two (2) inches. (Refer to Figure 4.8.)

4.2.17 Unplug the 3-pin connector for the Apnea switch at JP4 on the Main PCBA (refer to Figure 4.7). Note: If working on a PARTNER II*i*, unplug the 3-pin connector at J4 on the Heater PCBA (refer to Figure 4.9).

4.2.18 Unplug the 2-pin molex connector for the solenoid cable at JP5. (Refer to Figure 4.7.) This connector releases when you pinch and pull. To assemble, simply push and snap into place.

Figure 4.8 SIDE VIEW OF PARTNER

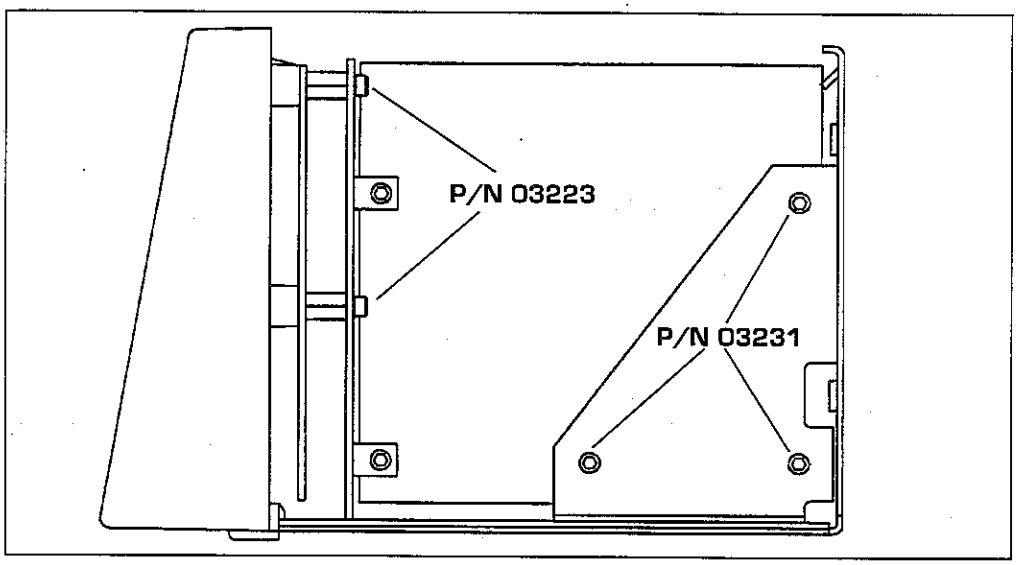
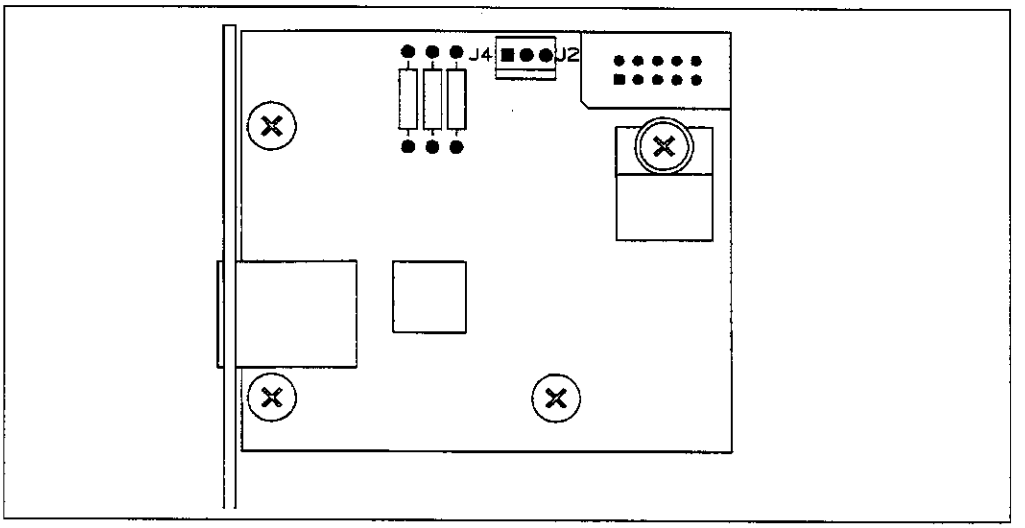


Figure 4.9 HEATER PCBA AND BRACKET (PARTNER II*i* only)



4.2.19 Grasp the end of the fiber optic cable connector near the Main PCBA (U18) and pull. (Refer to Figure 4.7.)

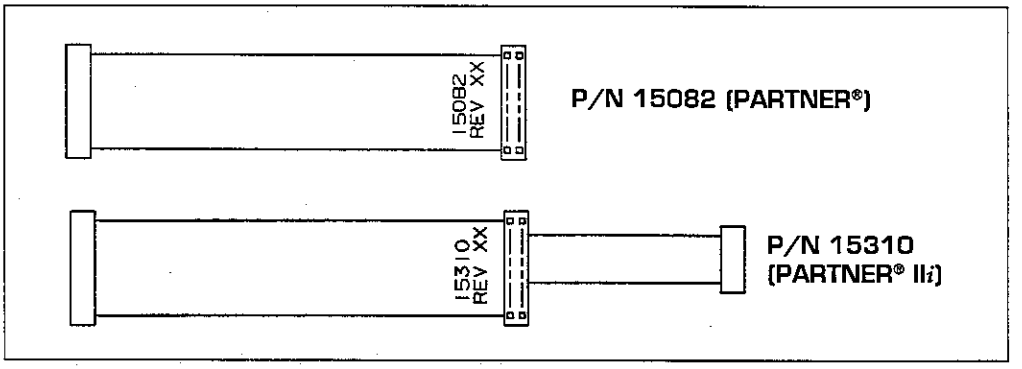
4.2.20 Unscrew the fiber optic cable DATA IN from the bulkhead panel connector below the gas inlet. (Refer to Figure 4.5.)

NOTE: A small thin pair of needle nose pliers may be needed to start the removal of the fiber optic cable.

4.2.21 Grasp the other end of the cable connector near the Main PCBA (U14) and pull. (Refer to Figure 4.7.)

4.2.22 Unplug the 20-pin ribbon cable connector at JP2 from the Main PCBA (refer to Figures 4.7 and 4.10). Note: If working on a PARTNER II*i*, also unplug the 10-pin ribbon cable connector at J2 on the Heater PCBA (refer to Figures 4.9 and 4.10).

Figure 4.10 RIBBON CABLES



4.2.23 The base unit is now separated into two parts. If no repair work is to be done on the front part of the PARTNER or if it has already been repaired, go to 4.2.31.

4.2.23.1 *Optional.* If the EPROM does not need to be changed or has already been changed, go on to 4.2.24.

4.2.23.2 *Optional.* Carefully push the multi-colored ribbon cable upwards to expose the main EPROM (U6) (refer to Figure 4.7); it will have a silver label with printing on it.

4.2.23.3 *Optional.* Note that the orientation notch on the end of the EPROM faces left. Using the EPROM removal tool, remove the EPROM. Use the EPROM insertion tool to replace the EPROM. Make certain that the small half circle notch is pointing to the left. Do not rely on the label printing for correct orientation. (Refer to Figure 4.7.)

4.2.24 Set the front panel assembly face down with the Main PCBA facing up.

4.2.25 Disconnect the 34-pin conductor ribbon cable at JP1. (Refer to Figure 4.7.)

4.2.26 Use a 1/4" wrench to remove the two (2) stand-off screws (P/N 33560). (Refer to Figure 4.7.)

4.2.27 Use a 7/64" Allen wrench to remove the two (2) screws (P/N 03223) on the right side of the PCBA. (Refer to Figure 4.7.)

4.2.28 Lift the Main PCBA (P/N 50120) away from the front panel assembly and place into an anti-static bag.

4.2.28.1 *Optional.* If the sensor receptacle is not to be replaced or has already been replaced, go on to 4.2.29.

4.2.28.2 *Optional.* Turn front panel assembly over so that overlay is facing up. Use a 3/32" Allen wrench to remove the four (4) screws (P/N 40013) from the flow receptacle and remove the flow receptacle (P/N 20189) from the front panel. Note that the receptacle has an orientation. Looking from the front, you will see a central hole and a hole off center, between the O-rings. The off center hole should be under the central hole. (Refer to Figure 4.1.)

4.2.29 Use a 7/64" Allen driver to remove the six screws (P/N 03223, 5 short screws) from the Display PCBA. Note that the screw (P/N 03221) through the sonalert is longer than the other five. To assemble, replace the long screw and then all of the others before tightening.

4.2.30 Lift the Display PCBA (P/N 50130) from the front panel assembly and place into an anti-static bag.

4.2.31 If no repair work is to be done to the Power PCBA, the power entry module, or the power switch, go on to 4.2.40.

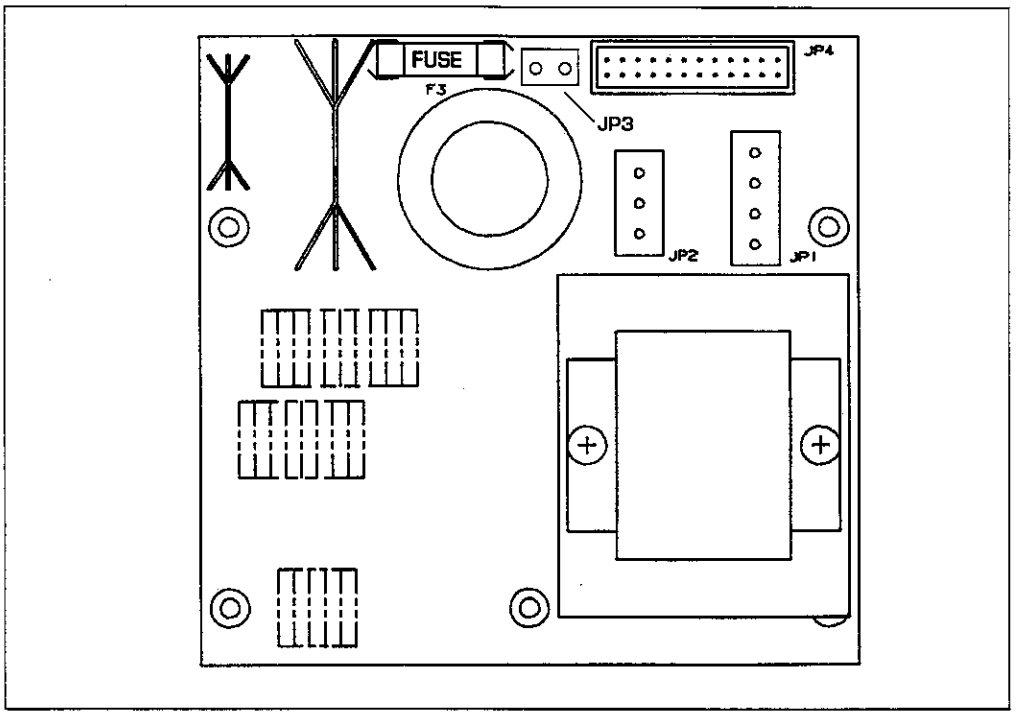
4.2.31.1 *Optional.* Remove the fuse on the Power PCBA (P/N 09255). (Refer to Figure 4.11.)

4.2.32 Remove the 20-pin conductor ribbon cable at JP4 from the Power PCBA. (Refer to Figure 4.11.)

4.2.33 Remove the 2-pin connector at JP3 from the Power PCBA. (Refer to Figure 4.11.)

4.2.34 Pinch and pull to remove the 4-pin molex connector at JP1 from the Power PCBA. (Refer to Figure 4.11.)

Figure 4.11 POWER PCBA



4.2.35 Pinch and pull to remove the 3-pin molex connector at JP2 from the Power PCBA. (Refer to Figure 4.12.)

4.2.36 Position the PARTNER so that the Power PCBA is facing you. Turn it over so that the bottom plate is now facing you. Using a 7/64" Allen wrench, remove the two (2) screws (P/N 03223) from the bottom plate releasing the mounting bracket attached to the Power PCBA. (Refer to Figure 4.6.)

4.2.37 Turn it back up so that the solder side of the Power PCBA is facing you.

4.2.38 Using a 7/64" Allen wrench, remove the three (3) screws (P/N 03231) from the permanent mounting bracket. To assemble, replace the three (3) screws loosely as well as the two (2) screws from 4.2.36, position the PCBA and then tighten the screws. (Refer to Figure 4.8.)

4.2.39 Slide the Power PCBA (P/N 50110) up and away from the base and place into an anti-static bag.

4.2.39.1 *Optional.* If the power entry module or the power switch are not to be replaced or if they have been replaced, go on to 4.2.40.

4.2.39.2 *Optional.* Using a 7/16" wrench, remove the two (2) nuts (P/N 01066) from the grounding stud and remove the ground lugs.

4.2.39.3 *Optional.* The power switch (P/N 03718) is retained in the back panel by spring loaded retainers. From the back, push on the top of the switch until the upper retainers clear the panel. Then push on the bottom of the switch to remove it from the panel. To assemble, check that the "0" marked on the face of the switch is down and push it until it snaps into the panel.

4.2.39.4 *Optional.* Remove the primary wire terminals from the power entry module (refer to Figure 4.4). To assemble, connect the primary wire terminals to their corresponding alpha numeric male terminal on the power entry module (refer to Figure 4.4).

4.2.39.5 *Optional.* Using a 5/16" wrench, remove the two (2) nuts (P/N 08558) on the power entry module. Remove the module. To assemble, check that the printing on the module is right side up. (Refer to Figure 4.4.)

4.2.40 Cut the cable tie strap or remove the hose clamp securing the braided pressure hose to the inlet manifold and remove the braided pressure hose from the inlet manifold by pulling and twisting firmly. To assemble, push the hose onto the nipple securing it with the hose clamp (P/N 33750).

4.2.41 Position the PARTNER so that the bottom plate is facing up. Using a 7/64" Allen wrench, remove the two (2) screws (P/N 03223) holding the solenoid block assembly. Turn the PARTNER back and remove the solenoid block assembly. (Refer to Figures 4.6 and 4.12.)

4.2.41.1 *Optional.* Make a drawing of the wire locations before removing the solenoid cable (P/N 15123). Remove the lug connectors from the solenoids; the best procedure is to remove one lug at a time and replace it with the corresponding lug of the new cable. (Refer to Figure 4.13.)

4.2.41.2 *Optional.* Using a 9/16" open end wrench, remove the filter retaining nut on the inside end of the gas inlet assembly (P/N 10104). Hold the outside nut with a 7/8" wrench. (Refer to Figure 4.14.)

4.2.41.3 *Optional.* Push a 1/8" Allen wrench through the inlet manifold nipple to dislodge and remove the nylon cone filter (P/N 06804) and O-ring (P/N 03374). To assemble, first insert the filter, pointed end first, and then insert the O-ring. Using a soft tool (a piece of tubing or pencil eraser), push the filter and O-ring to the bottom of the threads; be careful not to puncture the filter (refer to Figure 4.14).

Figure 4.12: Solenoid Block Assembly
Figure 4.13: Solenoid Cable Assembly
Figure 4.14: Inlet Manifold Assembly

Figure 4.12 SOLENOID BLOCK ASSEMBLY

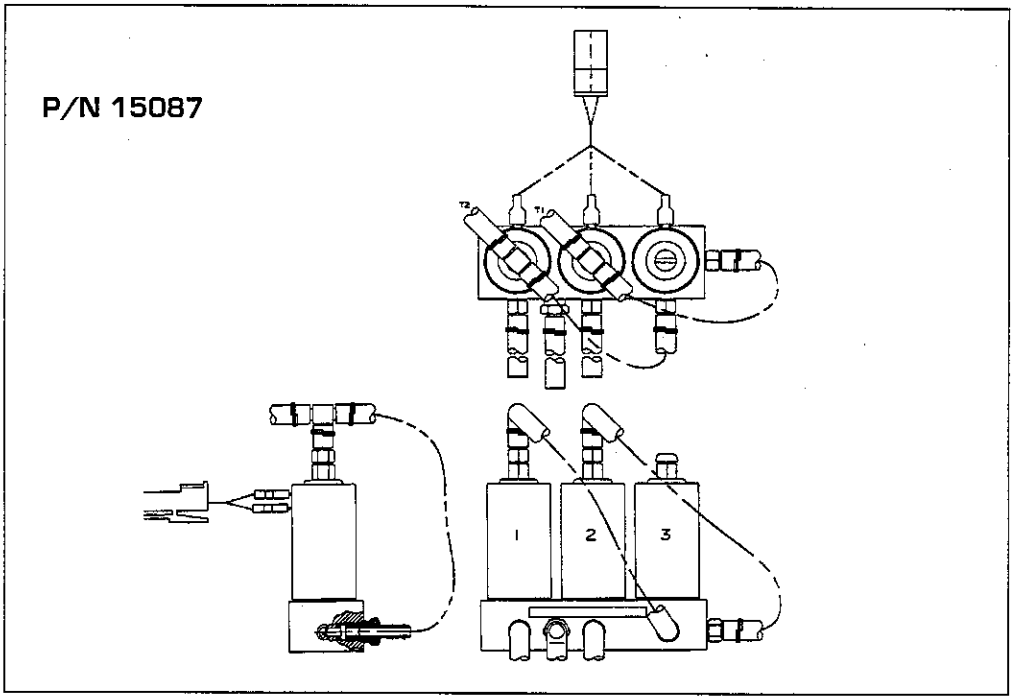


Figure 4.13 SOLENOID CABLE ASSEMBLY

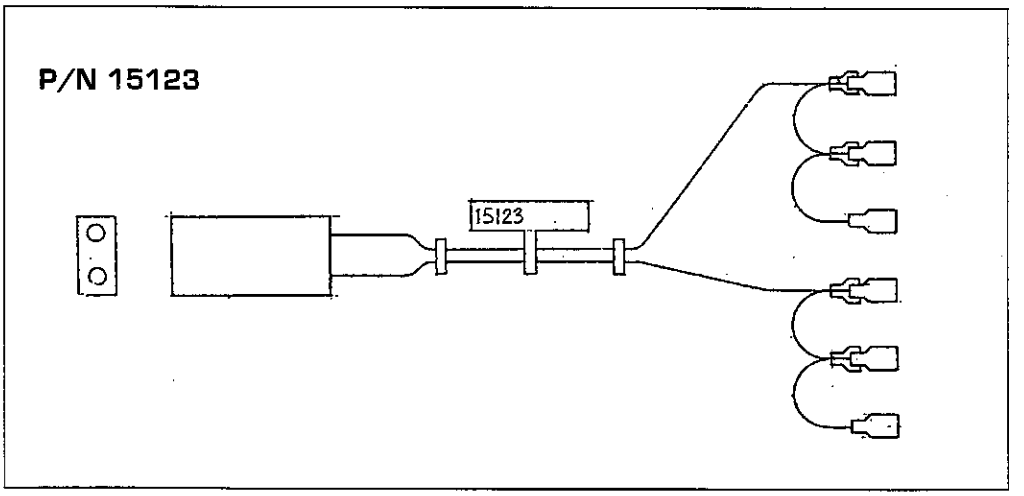
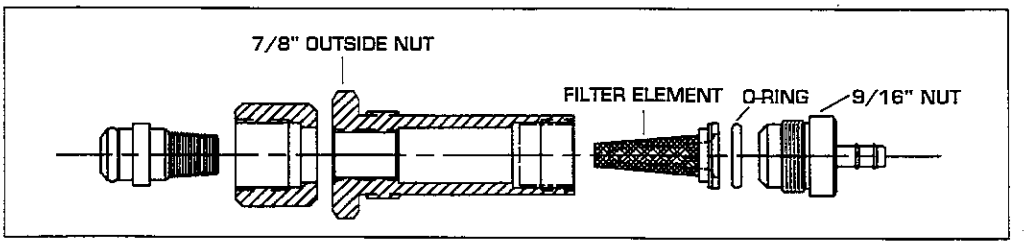


Figure 4.14 INLET MANIFOLD ASSEMBLY



4.2.42 To remove the gas inlet assembly (P/N 10104), hold the inside nut with an adjustable wrench and turn the outside nut with a 7/8" wrench. Remove the inside nut and washer and then remove the assembly. (Refer to Figure 4.14.)

4.2.43 To remove the Apnea switch and cable, remove the retaining nut and then remove the switch and cable. (Refer to Figure 4.15.)

NOTE: During reassembly care should be taken not to overtighten the Apnea switch retaining nut.

4.2.44 To remove the fiber optic bulkhead connectors (P/N 33528), hold the outer nut with a 3/8" wrench and loosen the inner nut with a 5/16" wrench. Remove the inner nut and washer. Ensure proper alignment of the bulkhead connectors with the "D" hole cutouts prior to tightening (refer to Figure 4.16.)

4.2.45 To remove the Heater PCBA, use a 5/16" open end wrench and remove the two (2) nuts (P/N 08558). Remove the Heater PCBA and Bracket and place in an anti-static bag. (Refer to Figure 4.9.)

4.2.46 Proceed to Section 5.0: Verification and Calibration Procedure.

NOTE: Before placing the PARTNER or PARTNER II*i* Volume Monitor into service, a Verification and Calibration Procedure must be performed.

Figure 4.15: Apnea Switch Assembly
Figure 4.16: Fiber Optic Bulkhead Fitting

Figure 4.15 APNEA SWITCH ASSEMBLY

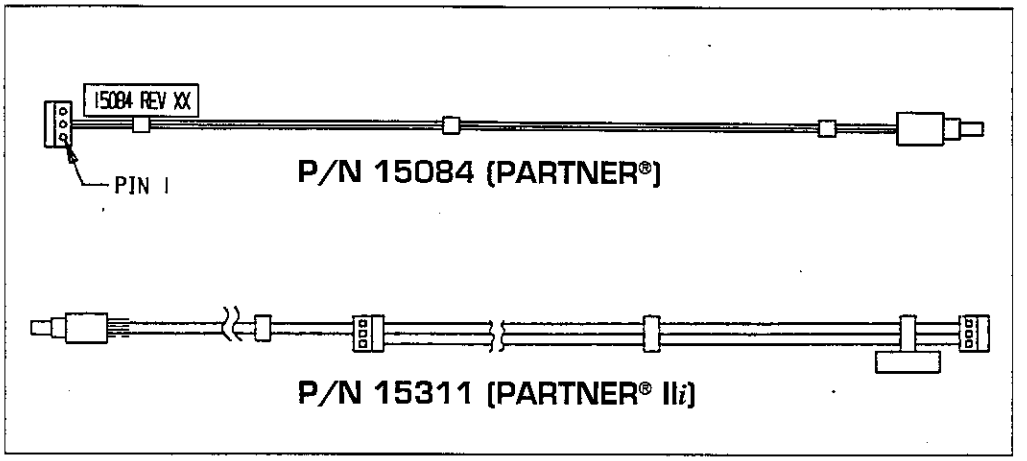
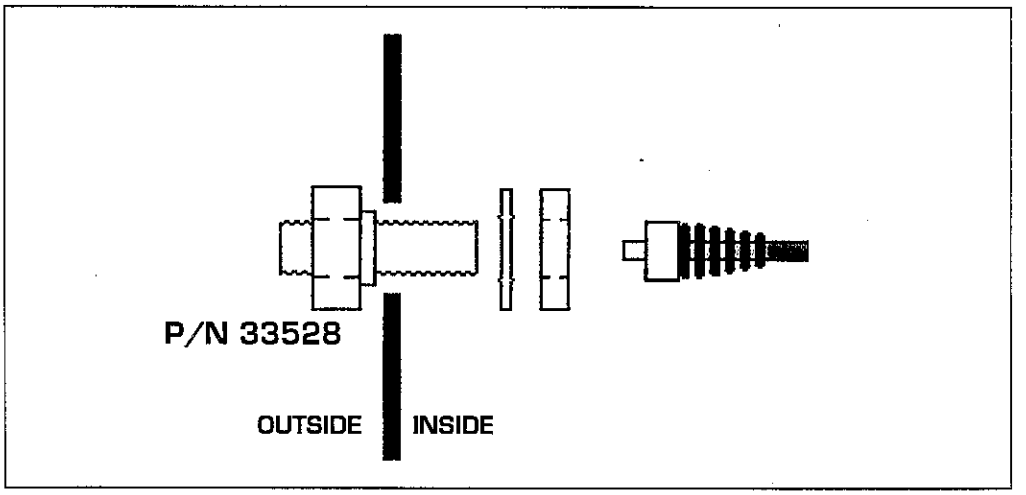


Figure 4.16 FIBER OPTIC BULKHEAD FITTING



Section 5.0

Calibration Procedure

SECTION 5.0: CALIBRATION PROCEDURE

5.1 INTRODUCTION

This section is specifically intended for use by an authorized service person; that is, a person who has attended a service seminar conducted or authorized by Bird Products Corporation. Any repairs, adjustments or procedures that exceed the scope of this manual should be referred to Bird Products Corporation's Technical Service Center.

NOTE: **For PARTNERS with software versions prior to 95.17, refer to the calibration procedure in the Addenda section. (For software version verification, please refer to Section 5.5.)**

5.2 SPECIAL TOOLS AND FIXTURES

- Infant Test Lung (P/N 10107)
- Collins Survey Spirometer, TB-063 or equivalent
- Patient Circuit (P/N 10088 & 10134)
- 0-140 VAC variac
- Air Supply Regulator with Pressure Gauge and On/Off Valve
- Master Manometer 0-5 cmH_2O or equivalent (±.05)
- Two Digital Multimeters, with AC True RMS current function
- V.I.P. BIRD® Infant-Pediatric Ventilator *with Flow Synchronization*
- RT-200 or equivalent
- Flow Transducer Test Harness (P/N 10234)
- 50cc Syringe
- Flow/Volume Sensor (P/N 15420)
- Torque Seal
- Stopcock Valve
- Tee 1/8" Tube Connector (P/N 00358)
- Test Manometer 0-140 cmH_2O

5.3 GAS INLET LEAKAGE TEST

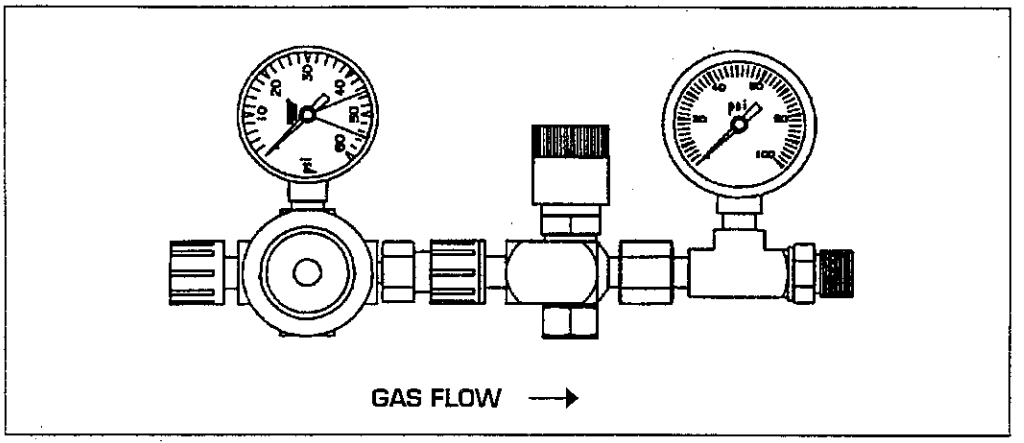
5.3.1 Connect PARTNER to the 50 PSI gas source. Turn supply pressure switch ON, adjust to 50 PSI and leave switch open for at least 10 seconds. Turn pressure supply switch OFF, as shown in Figure 5.1 on page 5-2.

5.3.2 Pressure must not drop below 45 PSI in 20 seconds. Verify result.

5.3.3 Remove the gas source.

SECTION 5.0: CALIBRATION PROCEDURE

FIGURE 5.1 SUPPLY PRESSURE TEST ASSEMBLY



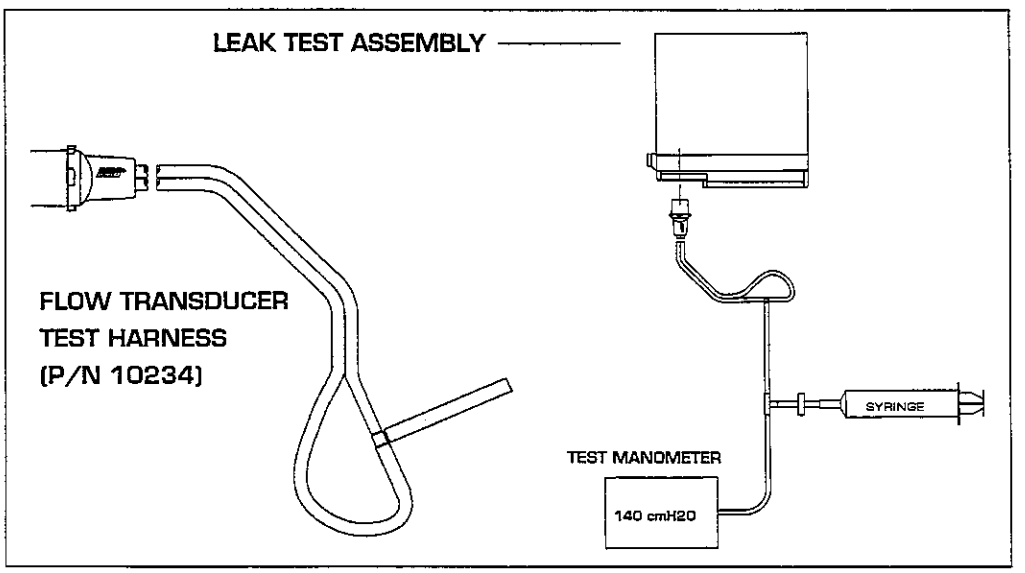
5.4 PNEUMATIC SYSTEM LEAKAGE TEST

5.4.1 Connect the flow transducer test harness (refer to Figure 5.2), to the PARTNER. Apply 140 cmH_2O through the flow transducer test harness using the syringe, as shown in Figure 5.2. Turn stopcock to close position.

5.4.2 Pressure must not drop below 122 cmH_2O (18cmH_2O) in 15 seconds, as indicated on test manometer. Verify result.

5.4.3 Remove flow transducer test harness.

FIGURE 5.2 FLOW TRANSDUCER TEST HARNESS & LEAK TEST ASSEMBLY



5.5 SOFTWARE VERIFICATION

5.5.1 While depressing the INSP. V_t (PARTNER II*i*) or Test (PARTNER) button, power up unit. Keep the INSP. V_t/Test button depressed until the Breath Rate window indicates "1". PARTNER will enter the "Test Mode". Release the INSP. V_t/Test button.

5.5.2 Verify displayed MAIN EPROM revision level in the Tidal Volume window. Record result.

5.5.3 Press the INSP. V_t/Test button. Breath Rate window will indicate "2".

5.5.4 Verify displayed Watchdog PAL revision level in the Tidal Volume window. Record result.

5.6 DISPLAY TEST

5.6.1 Press the INSP. V_t/Test button.

5.6.2 All segments of the seven (7) segment LEDs illuminate. The decimal points of the second and fourth LEDs, left to right, of the Tidal Volume display, will illuminate in the upper left hand corner of the LED instead of the lower right hand corner. All LEDs will illuminate, except as noted below. Verify result.

NOTES:
- The decimal point segments on the least significant digits of the High Breath Rate, Low Minute Volume, Breath Rate, and Minute Volume windows will not illuminate.
- The Mont. Inop. LED will not illuminate.

5.7 MONITOR INOP. ALARM VERIFICATION

5.7.1 Press the INSP. V_t/Test button. Breath Rate window will indicate "4".

5.7.2 While depressing the Alarm Silence/Reset button, press and release the INSP. V_t/Test button.

5.7.3 The PARTNER audible and visual "Monitor Inop." alarms will activate. All displays except the power LED will deactivate. Verify result. Turn power switch to the OFF position and depress Alarm Silence/Reset button.

SECTION 5.0: CALIBRATION PROCEDURE

5.8 EVENT CODE / CLEAR EEPROM

5.8.1 While depressing the INSP. V_t/Test button, power up unit. Keep the INSP. V_t/Test button depressed until the Breath Rate window indicates "1". Release the INSP. V_t/Test button.

5.8.2 Press the INSP. V_t/Test button four (4) more times. Tidal Volume, Breath Rate and Minute Volume windows will display "ClrE", "5", and the last event code seen by the software, respectively. If there have been no out of tolerance events seen by the software then "8FF" or "00" will appear in the Minute Volume window. (If needed, refer to APPENDIX A: Event Codes on page 5-14.)

5.8.3 Press and release the CONT. $\dot{V}$ to execute the CLEAR EEPROM function. The display will now read "Purg" "6" and the event codes will be cleared from memory.

5.9 PURGE VERIFICATION

5.9.1 Attach supply pressure test assembly (as shown in Figure 5.1 on page 5-2) to PARTNER; set supply pressure to 50 PSI and turn rotary switch to ON. Verify that "Purg" "6" is displayed in the Tidal Volume and Breath Rate windows.

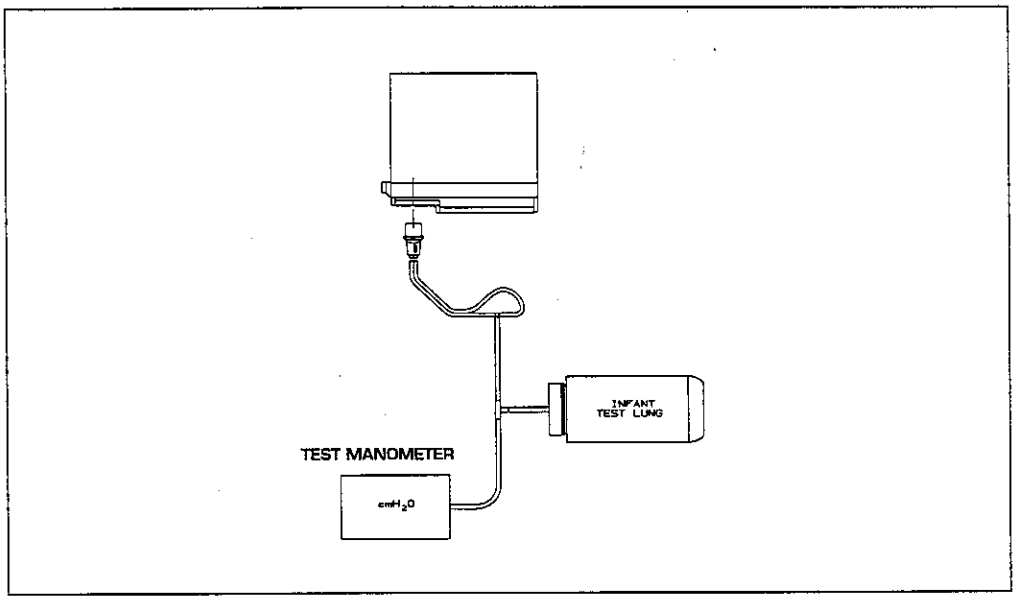
5.9.2 Connect the flow transducer test harness, test manometer (cmH_2O), and infant test lung, as shown in Figure 5.3 on page 5-5.

5.93 With the two (2) ports of the flow receptacle tied together, press the CONT. $\dot{V}$ button, and measure the pressure of purge gas delivered during the purge cycle.

5.9.4 Total pressure delivered through the ports of flow receptacle during a purge cycle must be greater than 10 cmH_2O and less than 30 cmH_2O. Record result.

5.9.5 Close the 50 PSI pressure supply switch. Remove the PARTNER from the 50 PSI pressure source.

FIGURE 5.3 PURGE VERIFICATION TEST ASSEMBLY



5.10 PRE-CALIBRATION WARM UP

5.10.1 While holding the INSP. V_t button depressed, power up the unit. PARTNER II*i* will enter the "Test Mode". Keep the INSP. V_t button pressed until the Breath Rate window indicates "1", then release the INSP. V_t button.

5.10.2 Allow the PARTNER to operate continuously for a period of thirty (30) minutes before calibration.

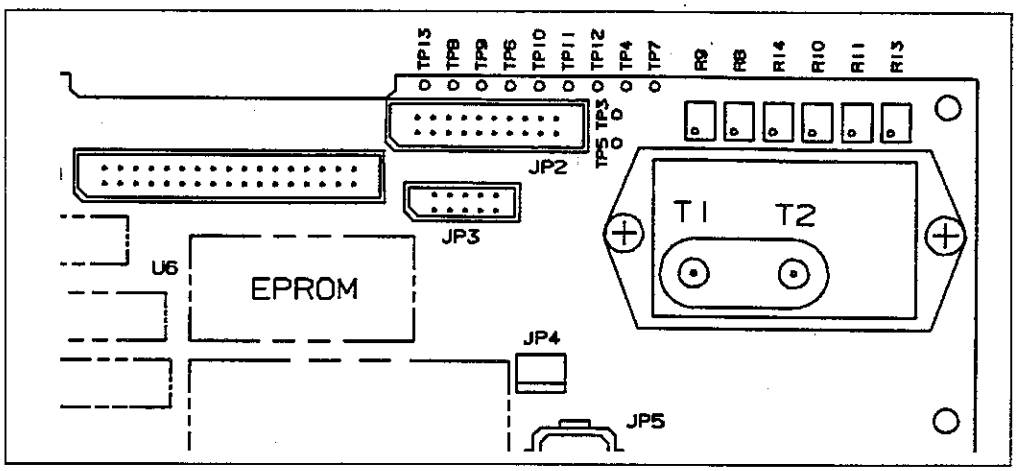
5.10.3 Press the INSP. V_t button until the Breath Rate display reads "7 **1**".

NOTES:
- Refer to Figure 5.4 on page 5-6 for all potentiometer locations.
- Allow the PARTNER to warm up for a period of thirty (30) minutes with the cover on before calibration.

POT	R10	R14	R9	R13	R8	R11
CHANNEL	EXPIRED	EXPIRED	INSPIRED	INSPIRED	WYE	WYE
@ 0 cmH_2O		ADJUST		ADJUST		ADJUST
@ 2 cmH_2O	ADJUST		ADJUST		ADJUST	
TEST PNT	DISPLAY	DISPLAY	DISPLAY	DISPLAY	DISPLAY	DISPLAY

SECTION 5.0: CALIBRATION PROCEDURE

Figure 5.4 POTENTIOMETER REFERENCE



5.11 INSPIRED FLOW CHANNEL CALIBRATION

NOTES:
- Bracketed tolerances at the end of each operational paragraph denotes allowance *after* Calibration.
- Use test setup as shown in Figure 5.5 for the pressure transducer calibration procedure.

CAUTION ✔

✔ **Do not** touch the heat sinks on the PARTNER II*i* Power Board (P/N 50110), as they are hot!

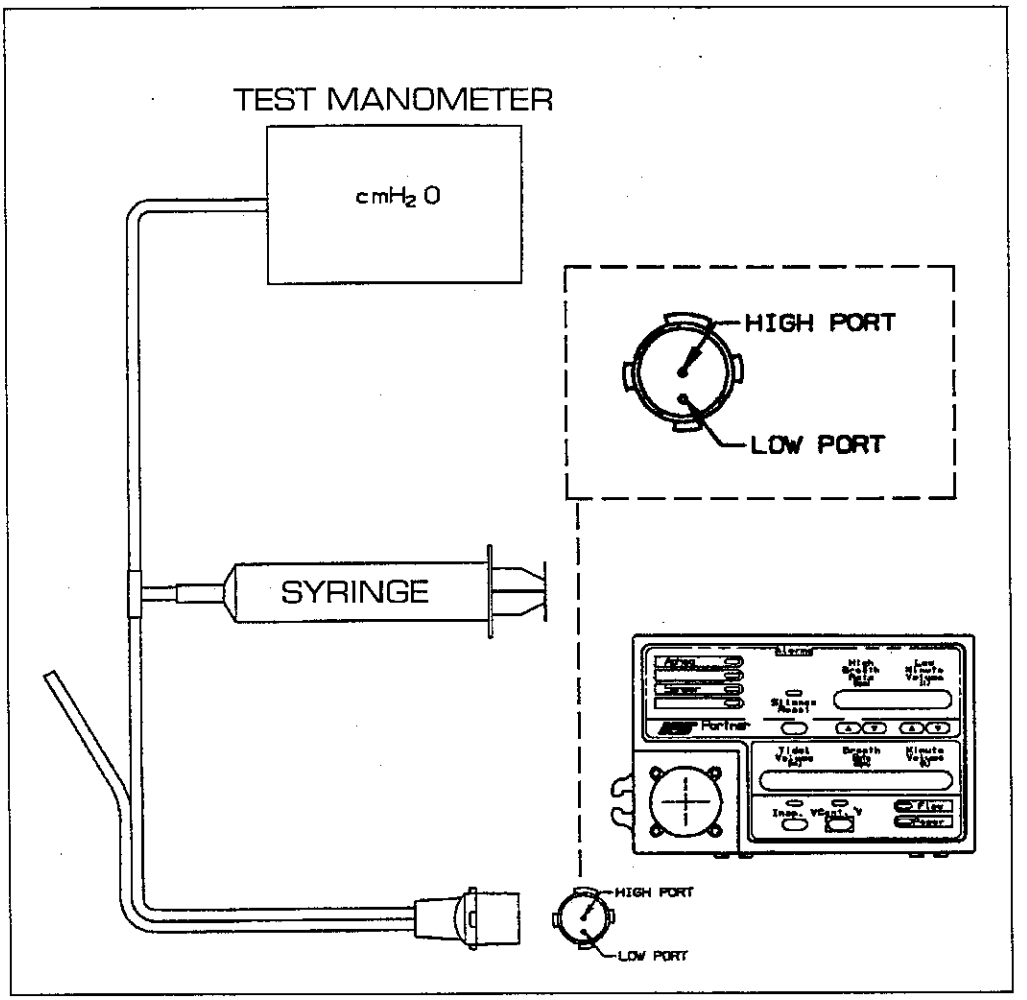
5.11.1 Ensure that the Minute Volume window displays **1**. With no pressure applied to either input port of the flow receptacle, adjust **R13** for a reading of 0.000 ±0.014. Record final reading. **[±0.048]**

5.11.2 Press the Cont.V button. The Minute Volume will change to **2**.

5.11.3 Connect positive side of manometer to HIGH port of flow receptacle. Using a pressure source (syringe) and manometer, apply 2.000 cmH_2O. Adjust R9 for a reading of 2.000 ±0.014. Record final reading. **[±0.018]**

5.11.4 Disconnect manometer and press the Cont. V button. The Minute Volume will change to **1**. Repeat Steps 5.11.1 through 5.11.4 until no further adjustments are required.

FIGURE 5.5 MANOMETER TO HIGH PORT OF FLOW RECEPTACLE CONNECTION



5.12 WYE FLOW CHANNEL CALIBRATION

5.12.1 Press the INSP. V_t button, Breath Rate display reads "**7 2**". Ensure that the Minute Volume window displays **1**. With no pressure applied to either input port of the flow receptacle, adjust R11 for a reading of 0.000 ±0.019. **[±0.048]**

5.12.2 Press the Cont.$\dot{V}$ button. The Minute Volume will change to **2**.

5.12.3 Connect positive side of manometer to HIGH port of flow receptacle. Using a pressure source (syringe) and manometer, apply 2.000 cmH_2O. Adjust R8 for a reading of 2.000 ±0.019. Record final reading. **[±0.028]**

5.12.4 Disconnect manometer and press the Cont.$\dot{V}$ button until the Minute Volume changes back to **1**. Repeat Steps 5.12.1 thru 5.12.4 until no further adjustments are required.

5.12.5 Press the Cont. $\dot{V}$ button until the Minute Volume changes to **3**. Connect positive side of manometer to Low port of flow receptacle. Using a pressure source (syringe) and manometer apply 2.000 cmH_2O. Verify reading of 2.000 ±0.019. Record reading. **[±0.028]** Disconnect pressure.

5.13 EXPIRED FLOW CHANNEL CALIBRATION

5.13.1 Press the INSP. V_t button, Breath Rate display reads "**7 3**". Ensure that the Minute Volume window displays **1**. With no pressure applied to either input port of the flow receptacle, adjust R14 for a reading of 0.000 ± 0.014. Record final reading. **[±0.048]**

5.13.2 Press the Cont.$\dot{V}$ button. The Minute Volume will change to **2**.

5.13.3 Connect positive side of manometer to HIGH port of flow receptacle. Using a pressure source (syringe) and manometer, apply 2.000 cmH_2O. Adjust R10 for a reading of 2.000 ±0.014. Record final reading. **[±0.018]**

5.13.4 Disconnect manometer and press the Cont.$\dot{V}$ button. The Minute Volume will change to **1**. Repeat Steps 5.13.1 through 5.13.4 until no further adjustments are required.

5.14 FIBER OPTIC LOOPBACK TEST

5.14.1 Press and release the INSP. V_t/Test button to display **"FoLb" "8".**

5.14.2 With nothing connected to either fiber optic connector, press and release the CONT. $\dot{V}$ button to execute test. Check that the display reads **FAIL**. Verify result.

5.14.3 Connect fiber optic cable (supplied with PARTNER P/N 15092) between the DATA IN and DATA OUT fiber optic connectors on the back of the PARTNER.

5.14.4 Check that the display reads **PASS**. Verify result.

5.15 FLOW SENSOR OPTICAL SWITCH VERIFICATION

5.15.1 Remove power to the PARTNER. Slide the PARTNER cover into place, but do not fasten it to the chassis.

5.15.2 Turn on the PARTNER without the Flow Transducer installed. The audible alarm will be continuous and the visual sensor alarm will flash. All displays will be dashed. Verify results.

5.16 HIGH BREATH RATE CONTROL RANGE VERIFICATION

5.16.1 Reconnect a flow/volume sensor. Cycle the High Breath Rate alarm setting incrementally by pressing the UP ▲ ARROW and DOWN ▼ARROW buttons directly beneath the High Breath Rate window. The alarm setting should move in 1 bpm increments.

5.16.2 Also verify that the High Breath Rate alarm setting will increment at a high rate by pressing and holding down the UP ▲ ARROW button and then the DOWN ▼ARROW button. Verify result.

5.17 LOW MINUTE VOLUME CONTROL RANGE VERIFICATION

5.17.1 Cycle the Low Minute Volume alarm setting incrementally by pressing the UP ▲ ARROW and DOWN ▼ARROW buttons directly beneath the Low Minute Volume window. The alarm setting should move in .01 lpm increments from 0.00 to 1.00 lpm, and in .1 lpm increments from 1.1 to 99.9.

5.17.2 Also verify that the Low Minute Volume alarm setting will increment at a higher rate (of speed) by pressing and holding down the UP ▲ ARROW button and the DOWN ▼ ARROW button. Verify result.

5.18 APNEA INTERVAL CONTROL RANGE VERIFICATION

5.18.1 Press the Apnea Interval switch once to temporarily display the current Apnea Interval setting in the Tidal Volume window. While the current setting is displayed, press the Apnea Interval switch to change the Apnea Interval Setting.

5.18.2 The Apnea Interval alarm setting must range from 10 to 60 seconds, in five (5) second increments. The Apnea Interval setting must roll over from 60 to 10. Verify result.

5.19 ELECTRICAL POWER DISRUPTION

5.19.1 Place the power ON/OFF switch in the **OFF** position.

5.19.2 The PARTNER's audible and visual Mont. Inop. alarms will activate. Verify result.

5.20 APNEA/SILENCE/RESET TEST

5.20.1 Set the Breath Rate on the V.I.P. BIRD® to 0. Adjust the PARTNER Apnea Interval Alarm to 10 seconds.

5.20.2 Activate the V.I.P. BIRD® Manual Breath button. At the end of the breath, activate the stopwatch. Measure the elapsed time between the delivered breath and the audible/visual Apnea alarm on the PARTNER.

5.20.3 The elapsed time from the end of the manual breath to Apnea alarm must be **10 ±1** seconds. Verify result.

5.20.4 Simultaneously press the Alarm Silence/Reset button and activate the stopwatch. Measure elapsed time until the audible alarm reactivates.

5.20.5 Audible alarm must silence for **60 ±5** seconds. Verify results.

5.20.6 Active the V.I.P. BIRD® Manual Breath button again. The audible alarm will cancel. Press the Alarm Silence/Reset button again. The visual alarm will cancel. Verify result.

5.21 HIGH BREATH RATE TEST

5.21.1 Adjust the High Breath Rate alarm to a rate higher than the ventilator setting.

5.21.2 The High Breath Rate audible and visual alarms will activate immediately. Verify result.

5.22 LOW MINUTE VOLUME TEST

5.22.1 Adjust the Low Minute Volume alarm to a value below the Minute Volume produced by the ventilator.

5.22.2 The Low Minute Volume audible and visual alarms will activate immediately. Verify result.

5.23 AC VOLTAGE OPERATING RANGE VERIFICATION

5.23.1 Adjust the variac to a line voltage of **102** ±1 VAC. The PARTNER will operate normally. Verify result.

5.23.2 Adjust the variac to a line voltage of **132** ±1 VAC. The PARTNER will operate normally. Verify result.

5.23.3 Continually adjust the variac between **88** to **94** VAC. Intermittent Monitor Inop. alarms will occur. Verify result.

SECTION 5.0: CALIBRATION PROCEDURE

Table 5.1 CALIBRATION RECORD/VERIFICATION CHARTS

NOTE: **30 minute warm up required before pressure transducer calibration.**

Procedure Reference	Description	R/V*	Calibration Record
5.3	Gas Inlet Leakage Test	V	
5.4	System Leakage (P drop<18 cmH_2O in 15 sec)	V	
5.5.2	Main EPROM Version	R	
5.5.4	PAL Version	R	
5.6	7 Segment Display Test	V	
5.7	Alarm Verification	V	
5.8	Clear EEPROM	V	
5.9	Purge Verification	R	

Procedure Reference	Description	R/V	Calibration Set Point
5.11.1	Zero Press. **±0.048**	R	
5.11.3	2 cmH_2O Press. **±0.018**	R	
5.12.1	(Wye 0) ±0.048	R	
5.12.3	2 cmH_2O Press. **±0.028**	R	
5.12.5	2 cmH_2O Press. **±0.028**	R	

Procedure Reference	Description	R/V	Calibration Record
5.13.1	Zero Press. **±0.048**	R	
5.13.3	2 cmH_2O Press. **±0.018**	R	

Procedure Reference	Description	R/V	Calibration Record
5.14.2	Fiber Optic Loopback Test - "FAIL"	V	
5.14.4	Fiber Optic Loopback Test - "PASS"	V	
5.15	Flow Transducer Disconnect Alarm	V	
5.16	Breath Rate Control Range	V	
5.17	Low Minute Volume Control Range	V	
5.18	Apnea Interval Control Range	V	
5.19	Power Disconnect Alarm	V	

Procedure Reference	Description	R/V	Record
5.20.3	Apnea Alarm 10 sec. ±1 sec.	V	
5.20.5	Alarm Silence	V	
5.20.6	Apnea Alarm Cancel	V	
5.21	High Breath Rate Alarm	V	
5.22	Low Minute Volume Alarm	V	
5.23.1	Normal Operation @ 102 VAC	V	
5.23.2	Normal Operation @ 132 VAC	V	
5.23.3	Monitor Inop @ 88 to 94 VAC	V	

R = Record result

V = Verify result

SECTION 5.0: CALIBRATION PROCEDURE

Appendix A EVENT CODES

When the PARTNER enters the MONT INOP state, the software dumps an event code to the most significant digit of the **TIDAL VOLUME** window. As the unit enters the INOP state, the event code is visible for only a fraction of a second. The event code is also stored in memory and can be recalled as described in Section 5.8. The event code can be useful in determining the cause of the persistent MONT INOP conditions.

When the event code is recalled from memory, the Graphic Event Code is displayed in the left most digit of the Minute Volume window and the corresponding Hex Code is displayed in the two right most digits of the Minute Volume window.

If a Bird Graphics Monitor is being used with the PARTNER/V.I.P. BIRD set up and a PARTNER INOP event occurs, the corresponding decimal value for the event will be displayed on the Bird Graphics Monitor. The PARTNER only stores one Event Code in memory. If a new event occurs, the code will overwrite the previous code.

Graphic Code	Hex Code	Decimal Value	Description	Probable Cause
	FF	(0.0)	Default values indicate no events have occured.	
	01	(1)	EEPROM is full	Bad EEPROM
	02	(2)	Failed 80C32 Internal RAM Test 1	Bad 80C32
	03	(3)	Failed 80C32 Internal RAM Test 2	Bad 80C32
	04	(4)	Failed 80C32 Internal RAM Test 3	Bad 80C32
	05	(5)	Failed 80C32 Internal RAM Test 4	Bad 80C32
	06	(6)	Failed 80C32 Internal Timer Test	Bad 80C32
	07	(7)	Failed EPROM Checksum Test	Bad EPROM
	08	(8)	Failed A/D channel 0 Test	Wye channel out of calibration or Bad A/D
	09	(9)	EEPROM pointer fault	Bad EEPROM
	0A	(10)	EEPROM pointer fault	Bad EEPROM
	18	(24)	Failed A/D channel 1 Test	Bad A/D
	28	(40)	Failed A/D channel 2 Test	INSPIRED channel out of calibration or Bad A/D

~~HEX~~ Code	~~Numeral~~ Code	Decimal Value	Description	Probable Cause
□	38	(56)	Failed A/D channel 3 Test	Bad A/D
□	48	(72)	Failed A/D channel 4 Test	Expired channel out of calibration or Bad A/D
□	58	(88)	Failed A/D channel 5 Test	Bad A/D
□	68	(104)	Failed A/D channel 6 Test	Bad +2.5V supply or Bad A/D
□	78	(120)	Failed A/D channel 7 Test	Bad +5V supply or Bad A/D
□.	88	(136)	Failed A/D channel 8 Test	Bad +5V supply or Bad A/D
□.	98	(152)	Failed A/D channel 9 Test	Bad +8V supply or Bad A/D
□.	A8	(168)	Failed A/D channel 10 Test	Bad +12V supply or Bad A/D
□.	B8	(184)	Failed A/D channel 11 Test	Bad A/D
□.	23	(35)	Failed solenoid causing high Δp for more than 6 sec.	Solenoid stuck on/off or leaking. Sensor tubing occluded.
□.	IC	(28)	Failed solenoid causing low Δp for more than 6 sec.	Solenoid stuck on/off or leaking. Sensor tubing occluded.

Section 6.0

Schematics & Drawings

PARTNER® & PARTNER® IIi Volume Monitors
Instruction & Service Manual

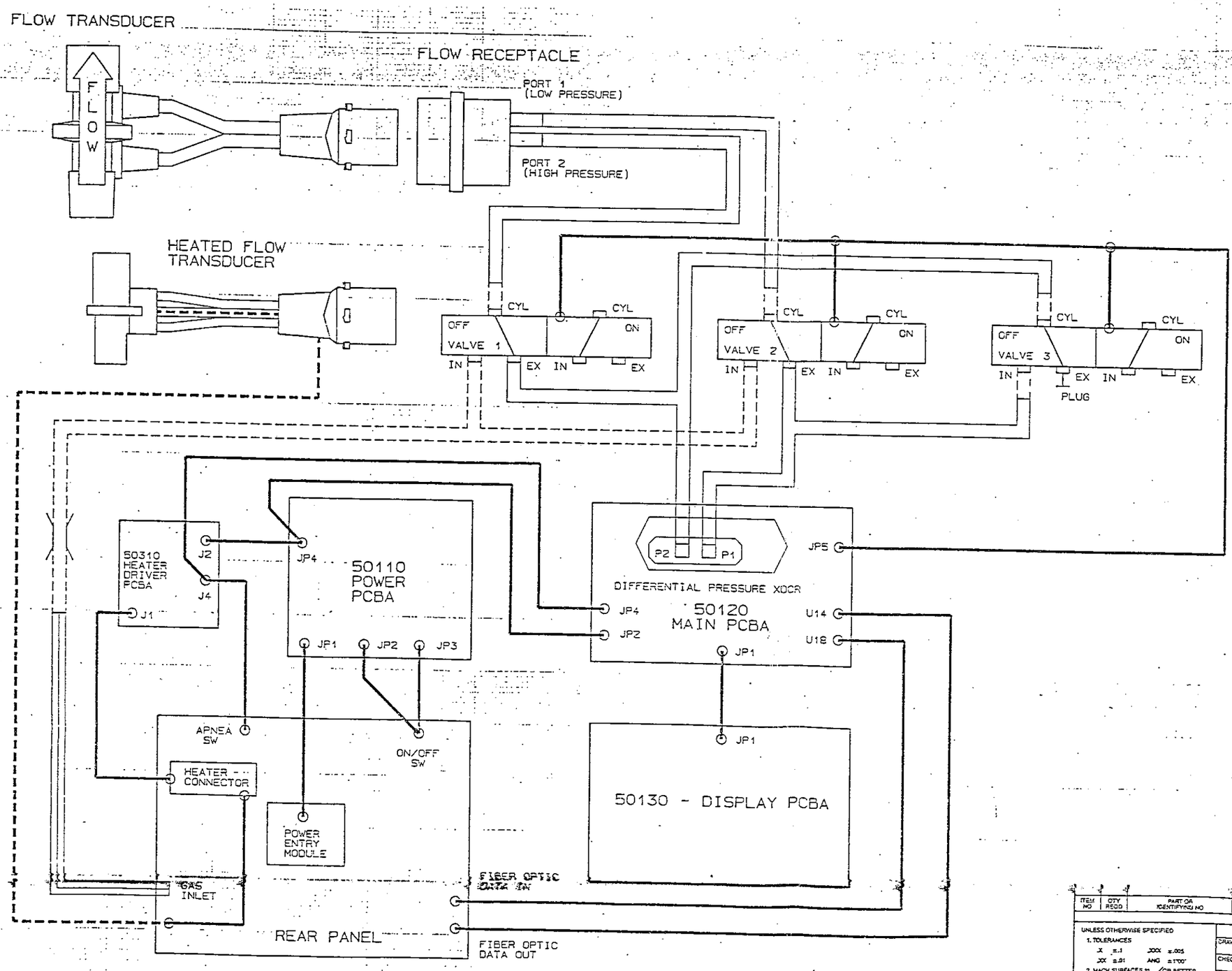
SECTION 6.0: SCHEMATICS & DRAWINGS

6.1 INTRODUCTION

Included in this section are the following schematics and drawings:

- Figure 6.1 — Block Diagram, System
- Figure 6.2 — Schematic, Display
- Figure 6.3 — Schematic, Main
- Figure 6.4 — Schematic, Power
- Figure 6.5 — Schematic, Heated Sensor Drive

FIGURE 6.1 BLOCK DIAGRAM, SYSTEM



REVISIONS				
SYM	DESCRIPTION	DRFTG	APPROVED	DATE
A	PROD REL PER ECO #50901	WVG	M.E.M.	3.16.93

NOTE: UNLESS OTHERWISE SPECIFIED.

1. THE THREE VALVES ARE WIRED IN PARALLEL. +12VDC IS APPLIED FROM THE MAIN PCBA TO TURN VALVES "ON"

KEY:

- SILICONE TUBING
- MANIFOLD PASSAGE
- BRAIDED TUBING
- ELECTRICAL WIRING
- TRANSDUCER WIRING

ITEM NO	QTY REQD	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION

MATERIAL LIST

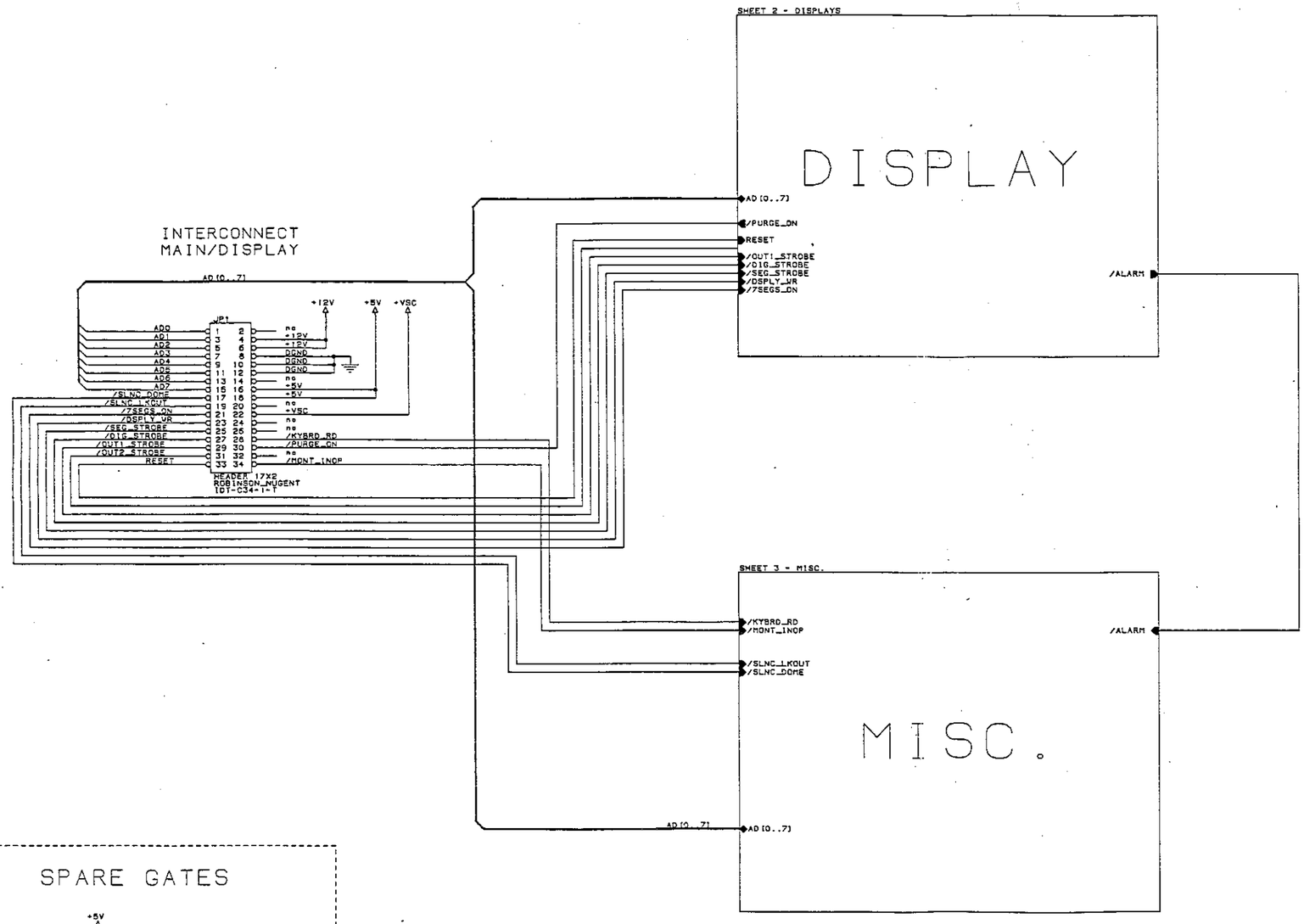
UNLESS OTHERWISE SPECIFIED
1. TOLERANCES
X ±.1 XXX ±.005
XX ±.01 ANG ±1°00'
2. MACH SURFACES √ OR BETTER
3. CORNER FILLETS & RADII .005/.010
4. BREAK ALL SHARP EDGES BY 45°
5. CHAMFER FIRST & LAST THREADS 45°
6. CONC TOLERANCE .005 F.I.M.

APPROVALS	DATE
DRAWN	
CHECKED WVG	01.06.93
M.E.M.	1-11-93
APPROVED	1-11-93
RELEASED	3.16.93
MATL	

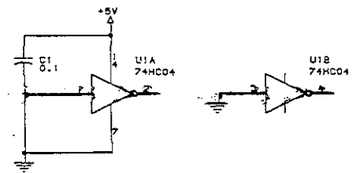
TITLE
BLOCK DIAGRAM, SYSTEM, PARTNER 2i

FIGURE 6.2 SCHEMATIC, DISPLAY

REVISIONS				
SYM	DESCRIPTION	DRFTG	APPROVED	DATE
X1	PILOT REL PER ECO 40759	DKB	DKB	9/24/90
A	PROD REL PER ECO 40971	WVG	DKB	2/6/91
B	INCORP PER ECO 41003	WVG	DKB	2.8.91
C	INC ECO 50003	EL	RAH	2-11-92



SPARE GATES



LAST USED REFERENCE:
C12
D3
DS28
R14
RP1
RS3
SP1
SW7
U10

NOTE: UNLESS OTHERWISE SPECIFIED.

ITEM NO	QTY REQD	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION

MATERIAL LIST

UNLESS OTHERWISE SPECIFIED
1. TOLERANCES
.X ±.1 .XXX ±.005
.XX ±.01 ANG ±1°00'
2. MACH SURFACES ✓ OR BETTER
3. CORNER FILLETS & RADII .005/.010
4. BREAK ALL SHARP EDGES BY 45°
5. CHAMFER FIRST & LAST THREADS 45°
6. CONC TOLERANCE .005 F.I.M.
7. INTERPRET PER ANSI Y14
8. DIMENSIONS ARE IN INCHES

APPROVALS	DATE
DRWG.	1-28-91
CHECKER	2-12-91
APPROVED	2-18-91
RELEASED	2-20-91
MAT'L	
FINISH	

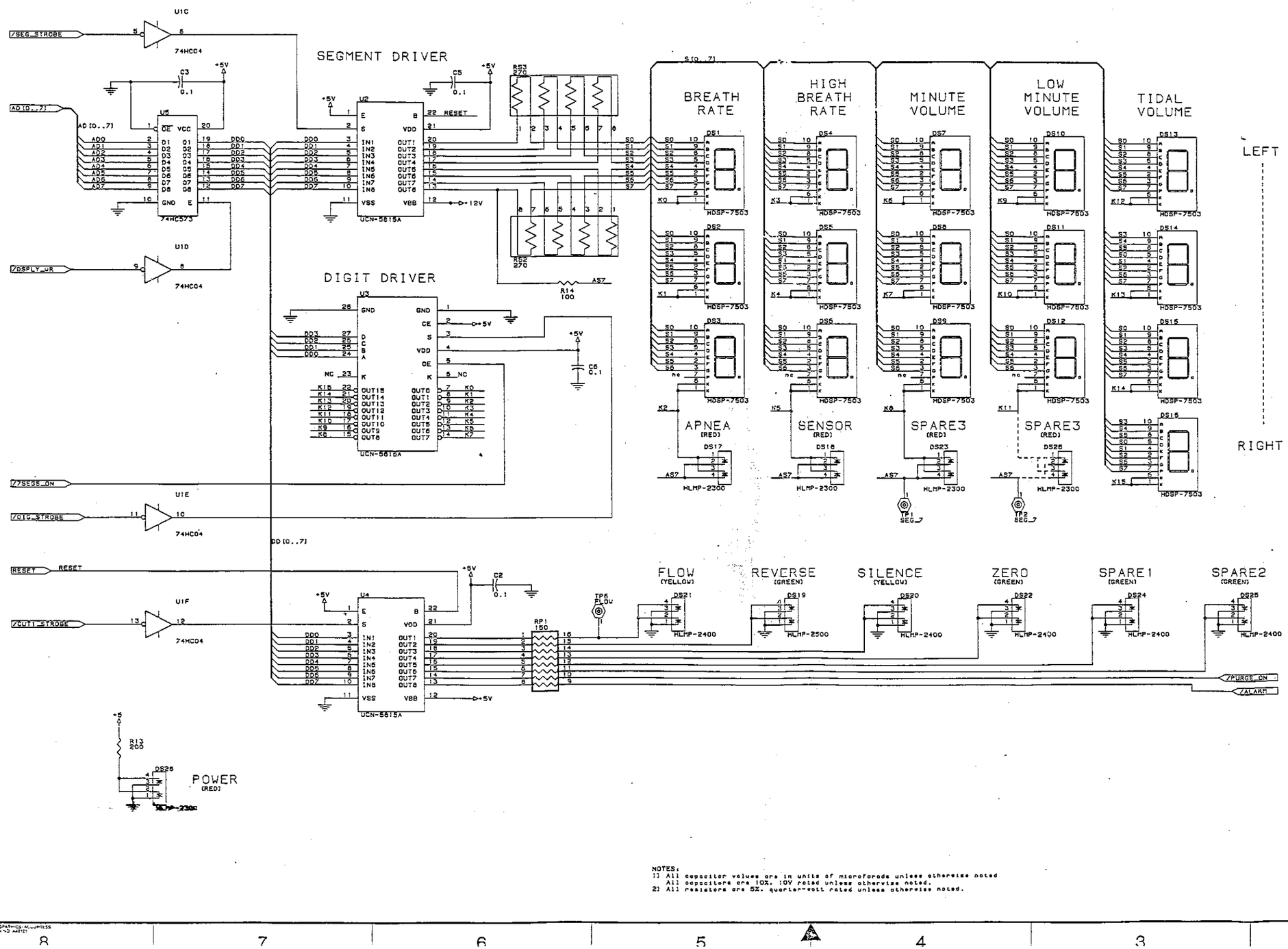
TITLE
SCHEMATIC, VM DISPLAY

D DWG NO. 50132 REV. C

SCALE NONE DO NOT SCALE DRAWING SHEET 1 OF 3

~~CAD DWG~~

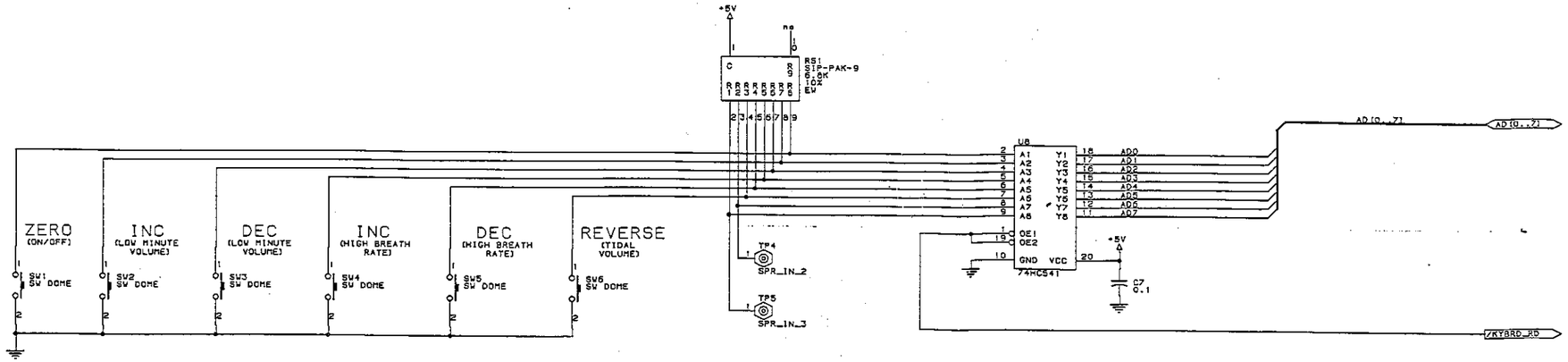
CRITICAL	☐ COMPONENT	☐ DEVICE	☐ N/A
TRACEABLE	☐ SERIAL NO.	☐ LOT NO.	☐ N/A



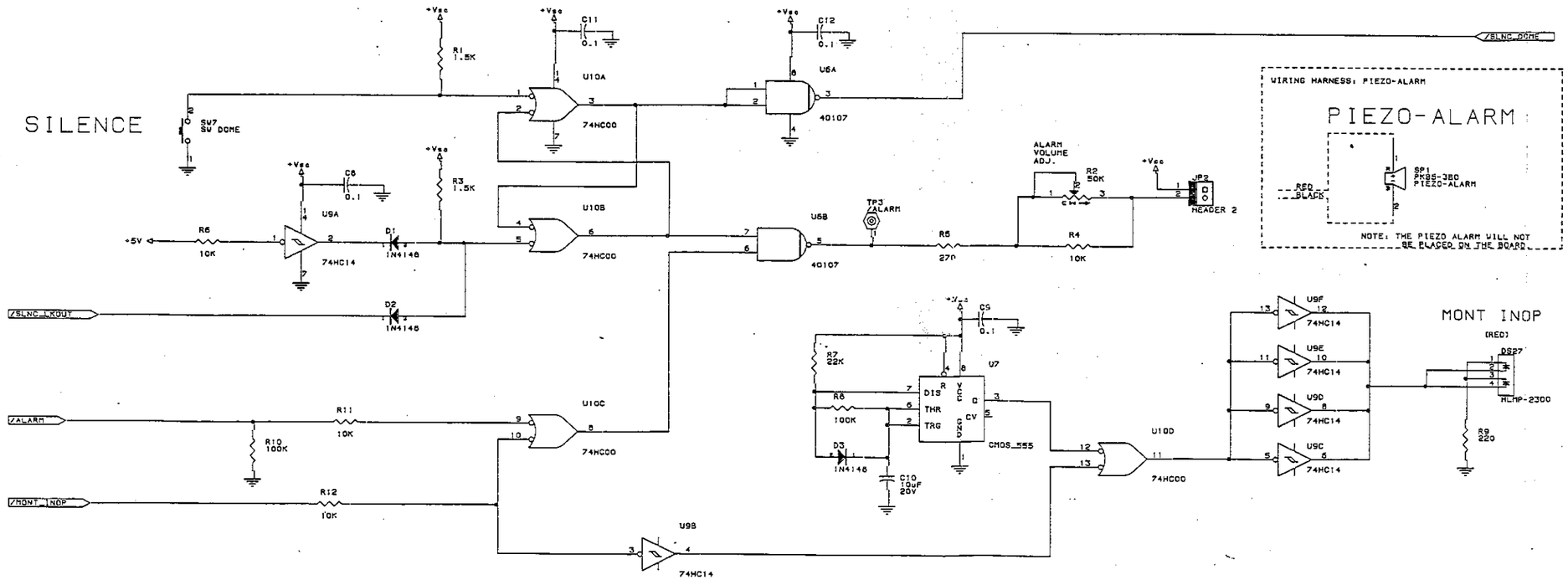
NOTES:
1) All capacitor values are in units of microfarads unless otherwise noted
   All capacitors are 10%, 10V rated unless otherwise noted.
2) All resistors are 5%, quarter-watt rated unless otherwise noted.

D	DWG NO. 50132	REV. C
SCALE	DO NOT SCALE DRAWING	SHEET 2 OF 3

FRONT PANEL PUSHBUTTONS



ALARM SILENCE/RESET CIRCUIT

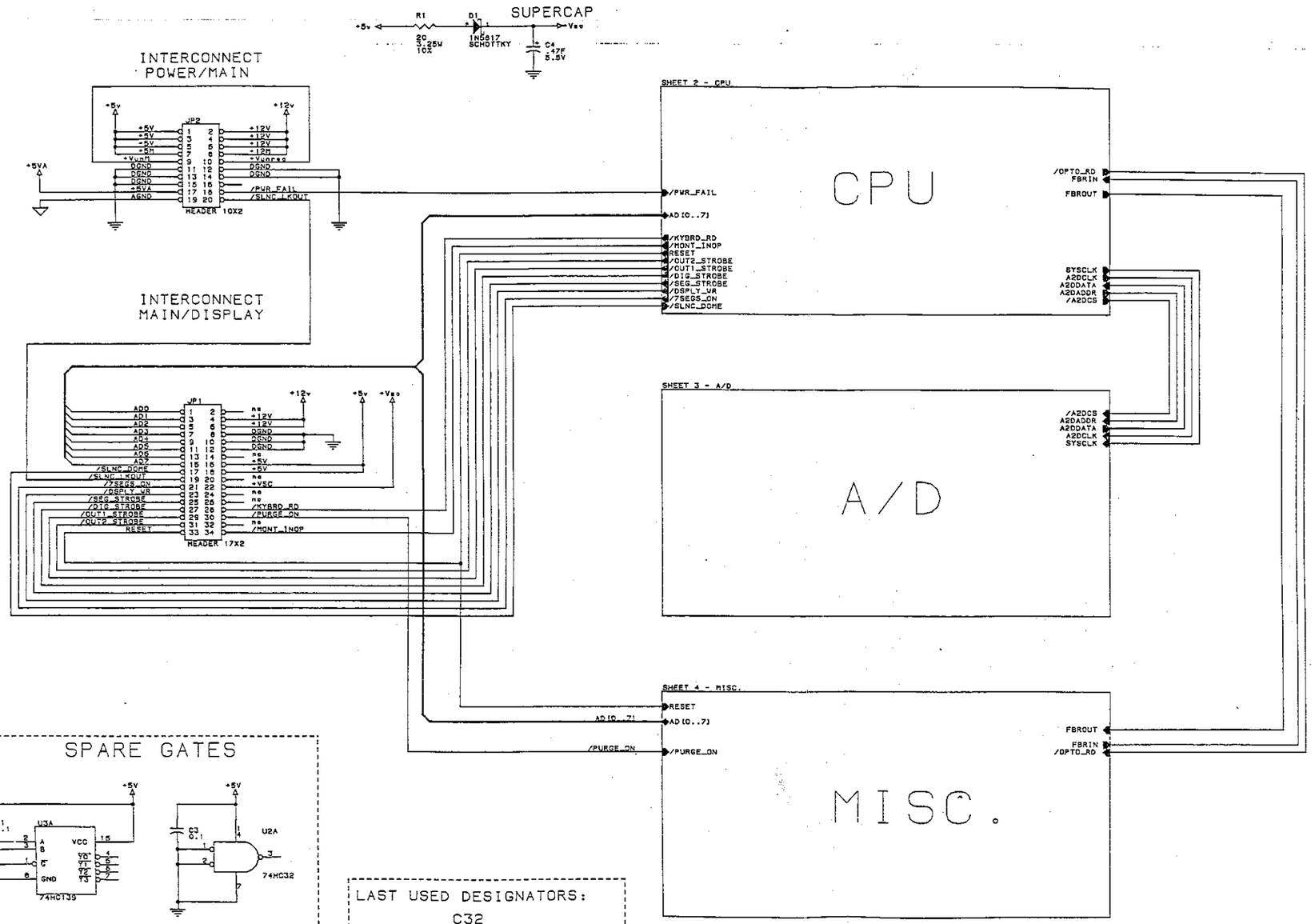


NOTES:
1) All capacitor values are in units of microfarads unless otherwise noted
   All capacitors are 10%, 10V rated unless otherwise noted.
2) All resistors are 5%, quarter-watt rated unless otherwise noted.

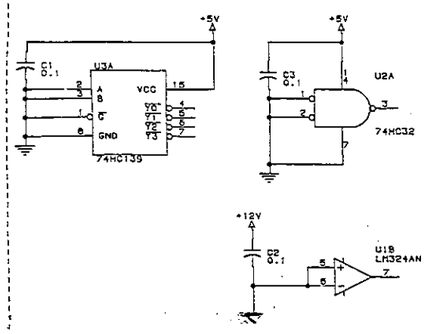
D	DWG NO. 50132	REV. C
SCALE	DO NOT SCALE DRAWING	SHEET 3 OF 3

FIGURE 6.3 SCHEMATIC, MAIN

REVISIONS				
SYM	DESCRIPTION	DRFTG	APPROVED	DATE
X1	PILOT REL PER ECO 40759	DKB	DKB	
X2	REV PER ECO # 40976	WVG	DKB	
X3	REV PER ECO # 40977	WVG	DKB	
A	PROD REL PER ECO # 40978	WVG	DKB	
B	REV PER ECO # 40979	WVG	DKB	
C	REV PER ECO # 40971	WVG	DKB	
D	REV PER ECO # 41003	WVG	DKB	
E	REV PER ECO # 50392	JKD		
F	REV PER ECO # 50060	JKD		
G	REV PER ECO # 51872	WH	WH	2.2.94
H	REV PER ECO # 51898	WH	WH	2.2.94



SPARE GATES



LAST USED DESIGNATORS:

C32
D5
ISO5
JP5
PT1
R48
RN3
U19
Y1

NOTE: UNLESS OTHERWISE SPECIFIED.

1. REVISION STATUS CHANGES TO THIS DRAWING MUST BE REFLECTED ON DRAWING 50120E.

CRITICAL	☐ COMPONENT	☐ DEVICE	☐ N/A
TRACEABLE	☐ SERIAL NO.	☐ LOT NO.	☐ N/A

ITEM NO | QTY. REQD | PART OR IDENTIFYING NO | NOMENCLATURE OR DESCRIPTION

MATERIAL LIST

UNLESS OTHERWISE SPECIFIED
1. TOLERANCES
X ±.1 XXX ±.005
~~XX ±.02 ANG ±1°~~
~~2 MACHINISTS' "X" OR BETTER~~
3. CORNER FILLETS & RADII .005/.010
4. BREAK ALL SHARP EDGES BY 45°
5. CHAMFER FIRST & LAST THREADS 45°
6. CONC TOLERANCE .005 F.I.M.
7. INTERPRET PER ANSI Y14
8. DIMENSIONS ARE IN INCHES

APPROVALS	DATE
DRAWN WVG	1-21-91
CHECKED D. BOYLE	2-13-91
APPROVED D. BOYLE	2-13-91
RELEASED	
MAT'L	
FINISH	

TITLE: SCHEMATIC, VM MAIN

D | DWG NO. 50122 | REV. H

SCALE NONE | DO NOT SCALE DRAWING | SHEET 1 OF 4

EEPROM

CPU

LATCH

EPROM

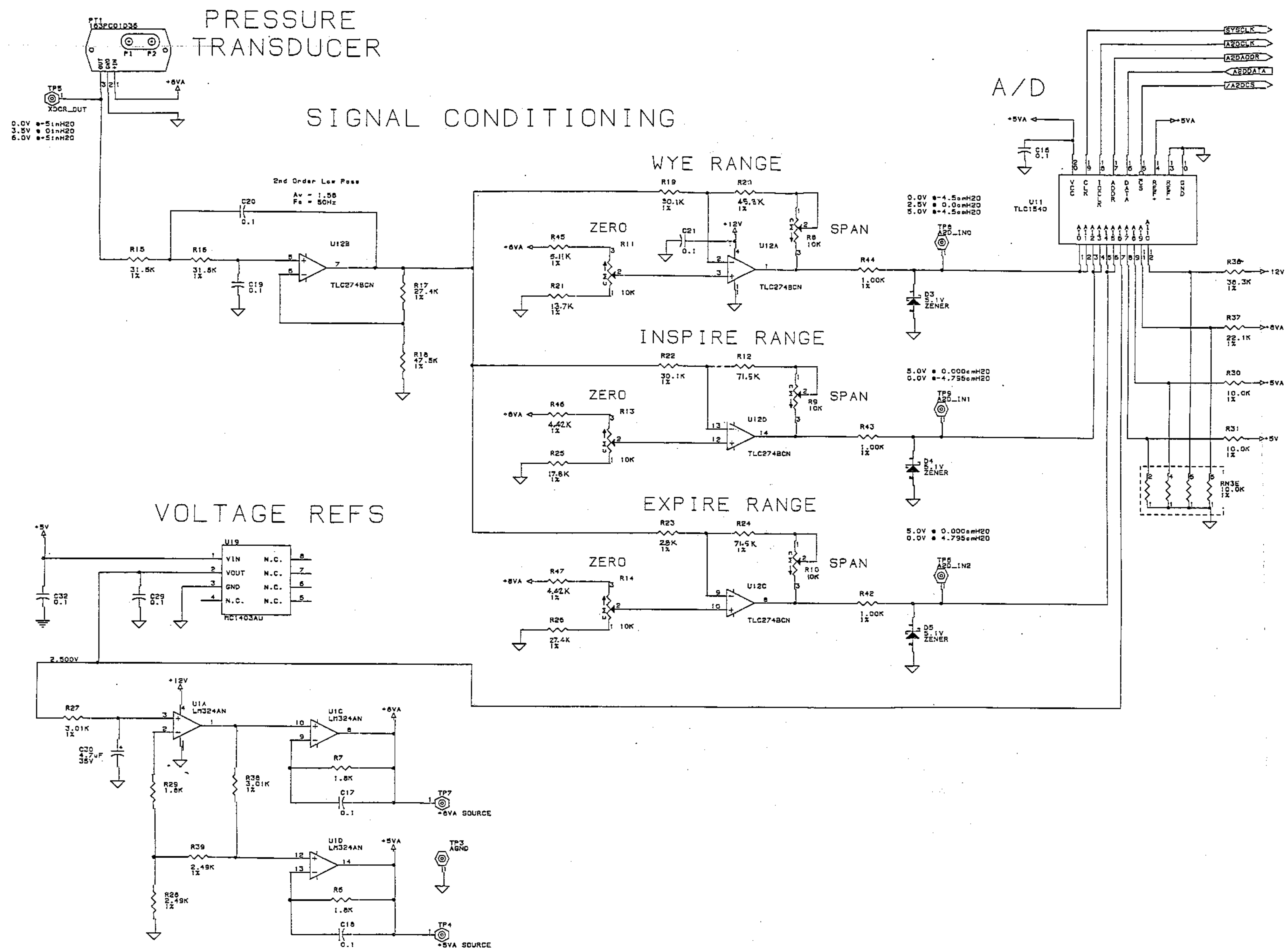
PAL

WATCHDOG

DECODER

NOTES:
1) [illegible]
2) All resistors are 5%, quarter-watt rated unless otherwise noted.
3) All 1% resistors are eighth-watt rated unless otherwise noted.

D	DWG NO. 50122	REV. H
SCALE NONE	DO NOT SCALE DRAWING	SHEET 2 OF 4



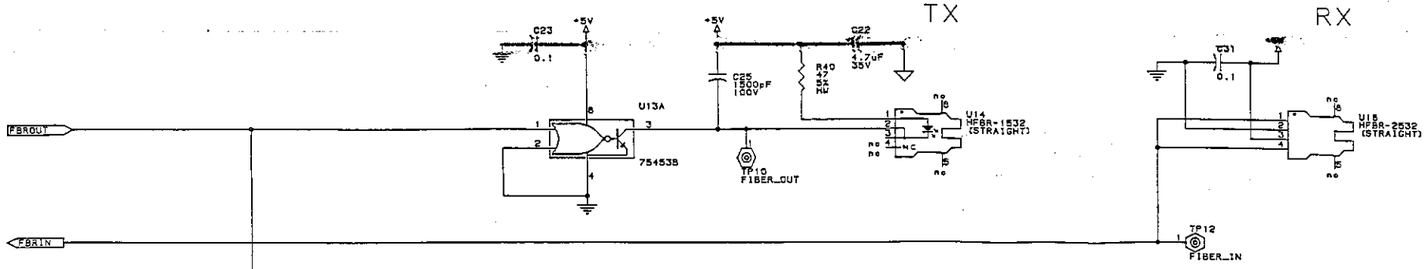
NOTES:
1) All capacitor values are in units of microfarads unless otherwise noted
All capacitors are 10%, 50V rated unless otherwise noted.
~~2) All resistors are 5% [illegible] rated unless otherwise noted.~~
~~3) All 1% resistors are [illegible] rated unless otherwise noted.~~

D	DWG NO. 50122	REV. H
SCALE NONE	DO NOT SCALE DRAWING	SHEET 3 OF 4

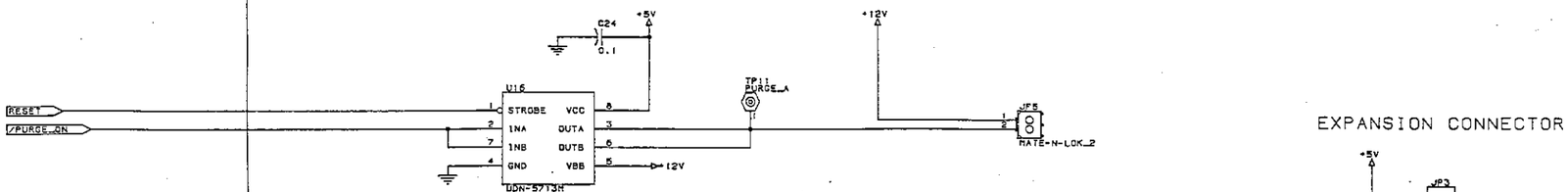
FIBER OPTIC OUTPUT LINKS

TX

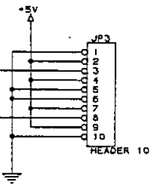
RX



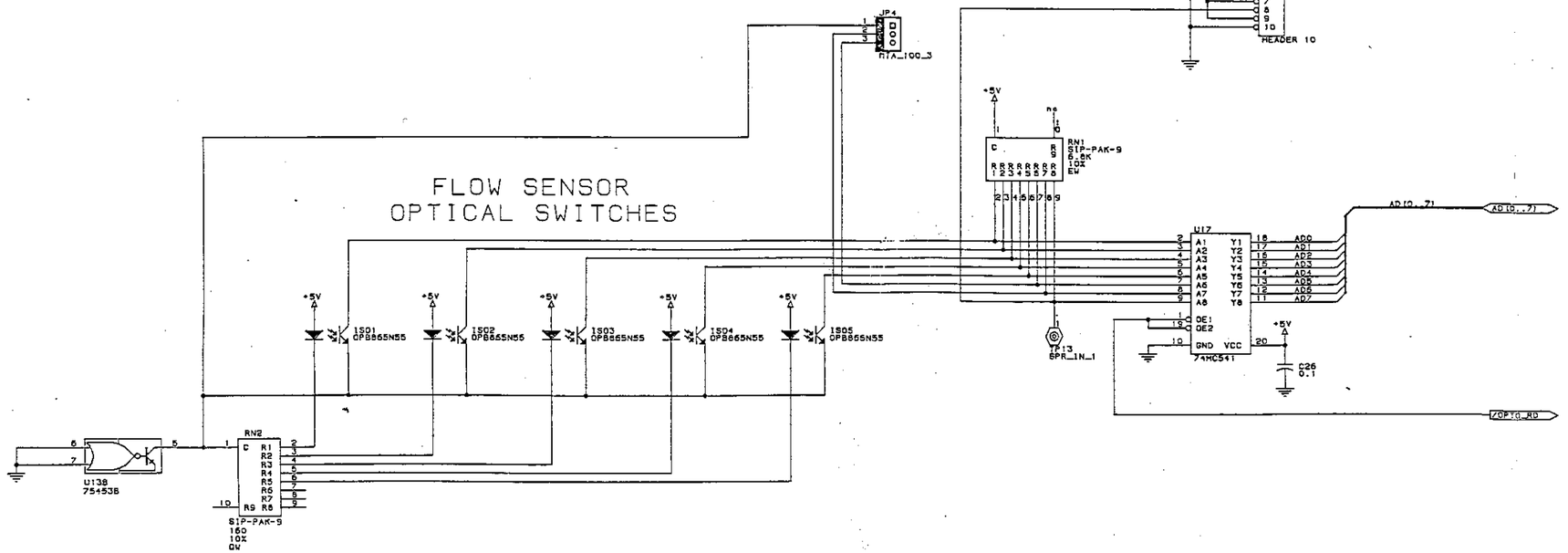
PURGE DRIVERS



EXPANSION CONNECTOR



FLOW SENSOR OPTICAL SWITCHES

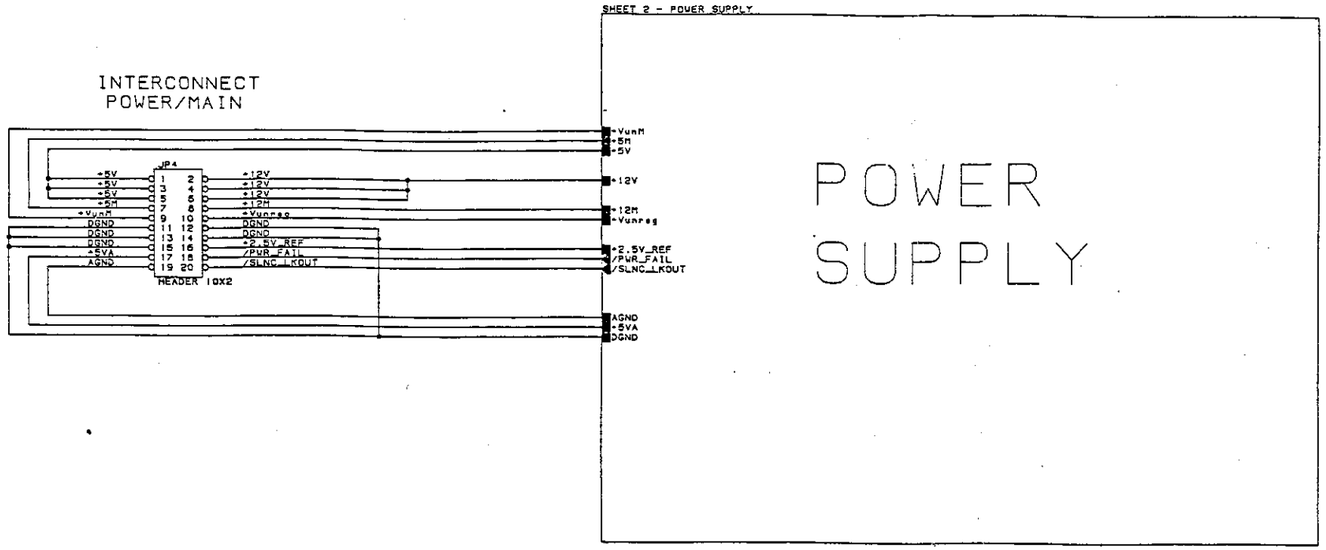


NOTES:
1) All capacitor values are in units of microfarads unless otherwise noted
   All capacitors are 10%, 10V rated unless otherwise noted.
2) All resistors are 5%, quarter-watt rated unless otherwise noted.

D	DWG NO. 50122	REV. H
SCALE NONE	DO NOT SCALE DRAWING	SHEET 4 OF 4

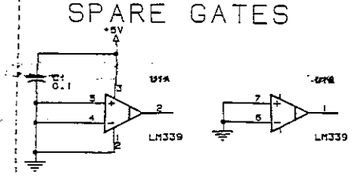
FIGURE 6.4 SCHEMATIC, POWER

REVISIONS				
SYM	DESCRIPTION	DRFTS	APPROVED	DATE
X1	PILOT REL PER ECO 40759	DKB	DKB	9/24/90
X3	INCORP PER ECO 40974	WVG	DKB	2/6/91
A	PROD REL PER ECO 40975	WVG	DKB	2/6/91
B	INCORP PER ECO 40971	WVG	DKB	2/6/91
C	INCORP PER ECO 41003	WVG	DKB	2/13/91
D	INCORP PER ECO 36458	EL		7-18-91



NOTE: UNLESS OTHERWISE SPECIFIED.

SPARE GATES



LAST USED DESIGNATORS:

C13
~~D4~~
JP4
R27
T1
U6

CRITICAL	☐ COMPONENT	☐ DEVICE	☐ N/A
TRACEABLE	☐ SERIAL NO.	☐ LOT NO.	☐ N/A

ITEM NO	QTY REQD	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION

MATERIAL LIST

UNLESS OTHERWISE SPECIFIED
1. TOLERANCES
.XX ±.01 ANG ±1°00'
2. MACH SURFACES √ OR BETTER
3. CORNER FILLETS & RADII .005/.010
4. BREAK ALL SHARP EDGES BY 45°
5. CHAMFER FIRST & LAST THREADS 45°
6. CONC TOLERANCE .005 F.I.M.
7. INTERPRET PER ANSI Y14
8. DIMENSIONS ARE IN INCHES

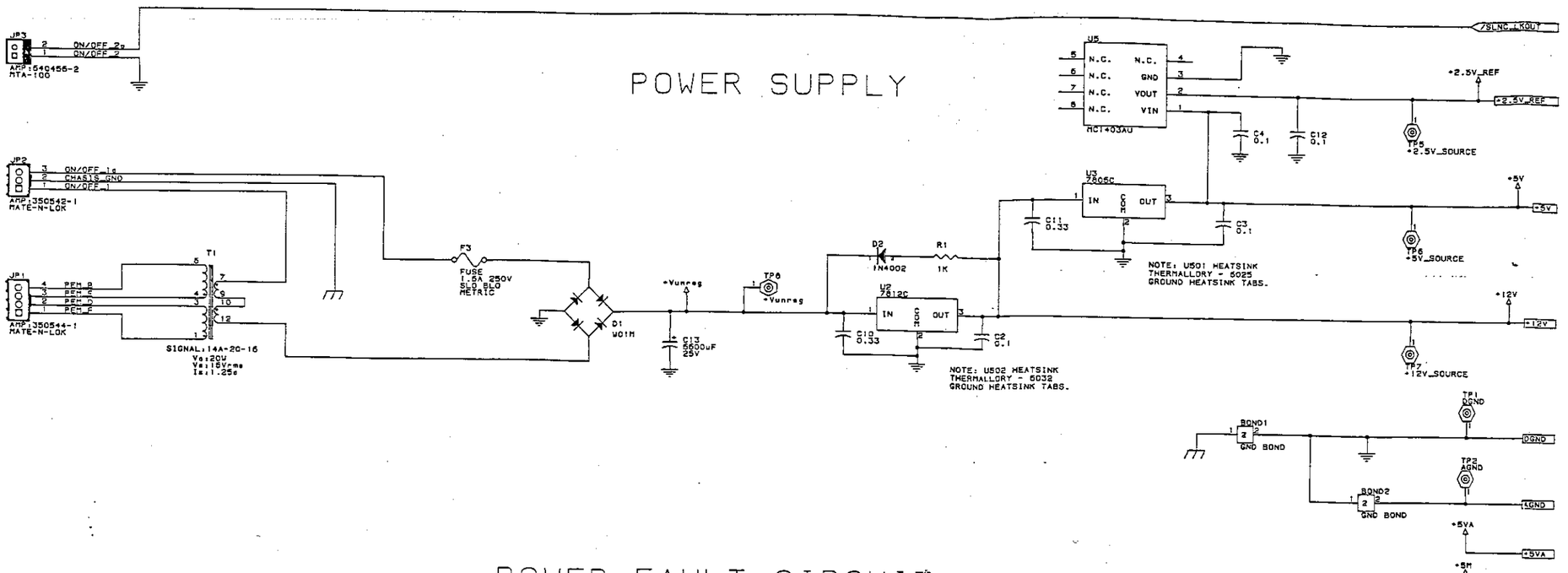
APPROVALS	DATE
DRAWN W.V.G.	1-31-91
CHECKED D. BOYLE	2-6-91
APPROVED D. BOYLE	2-6-91
RELEASED	2-22-91
MAT'L	
FINISH	

TITLE: SCHEMATIC, VM POWER

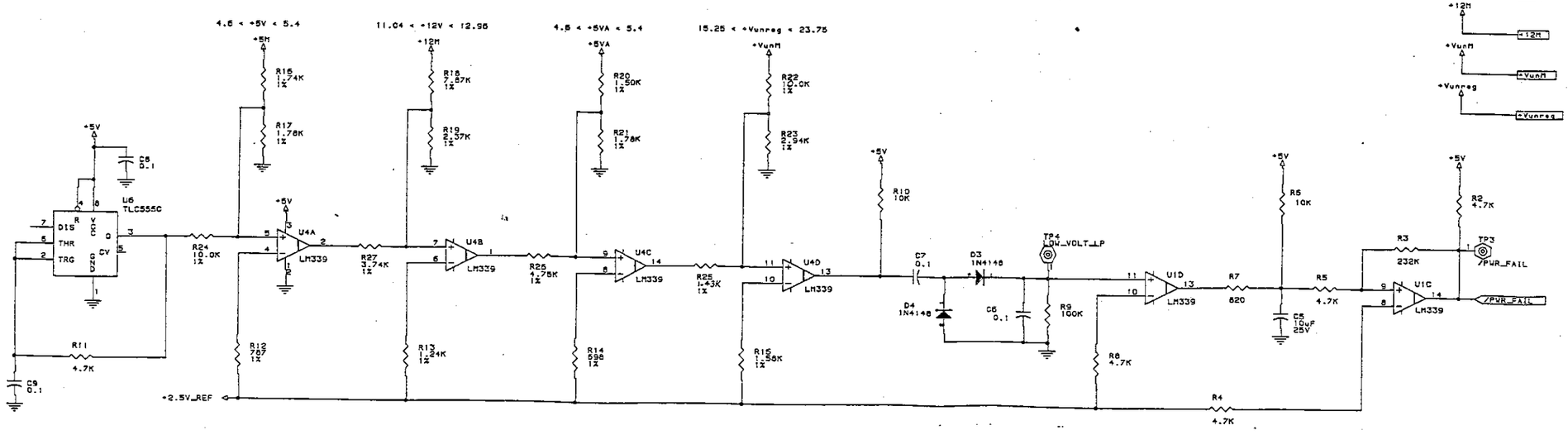
D | DWG NO. 50112 | REV. D

SCALE NONE | DO NOT SCALE DRAWING | SHEET 1 OF 2

POWER SUPPLY



POWER FAULT CIRCUIT

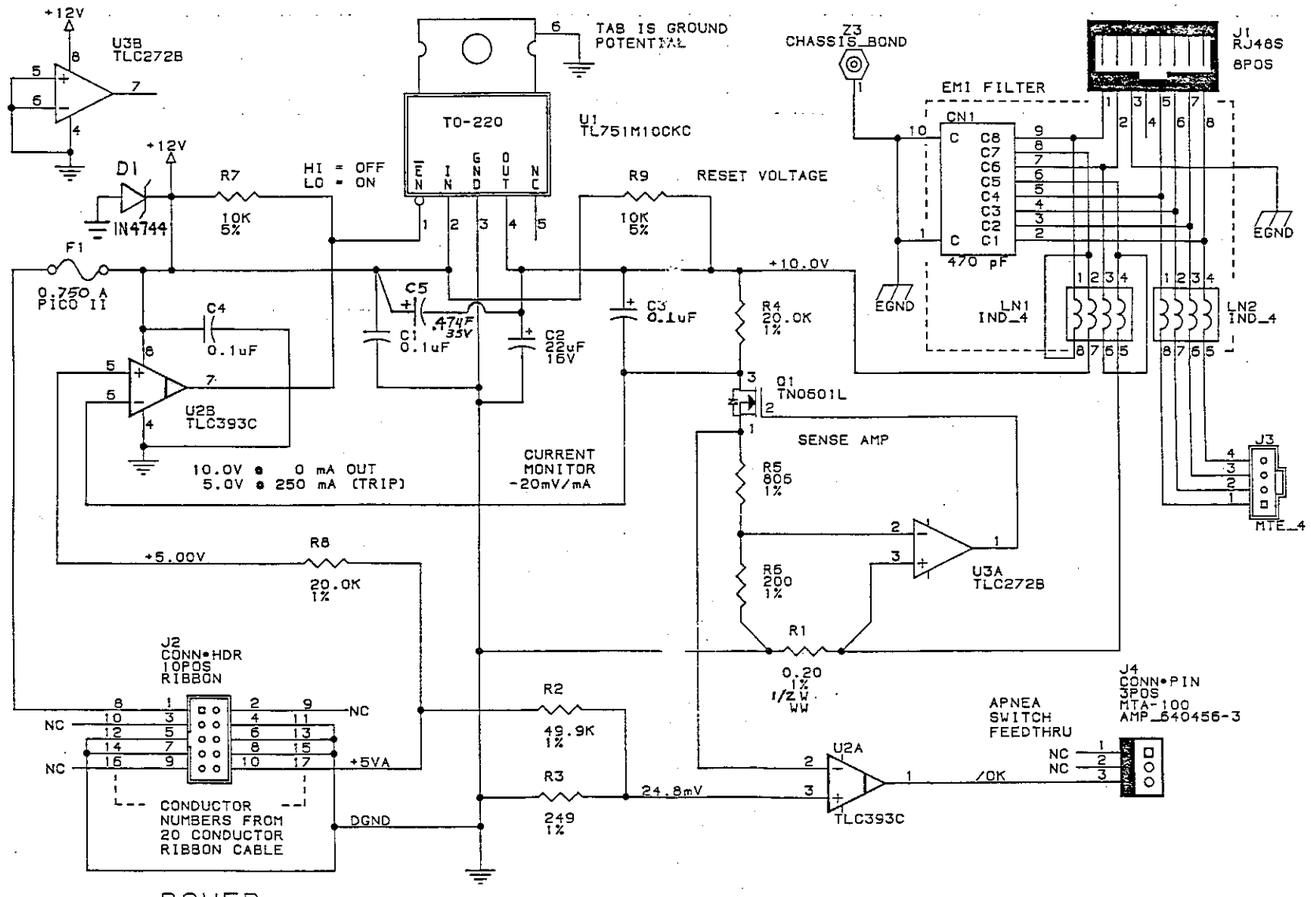


NOTES:
1) All capacitor values are in units of microfarads unless otherwise noted
   All capacitors are 10%. 50V rated unless otherwise noted.
2) All resistors are 5%. quarter-watt rated unless otherwise noted.
3) All 1% resistors are eighth-watt rated unless otherwise noted.

D	DWG NO. 50112	REV. D
SCALE	DO NOT SCALE DRAWING	SHEET 2 OF 2

FIGURE 6.5 SCHEMATIC, HEATED SENSOR DRIVE

REVISIONS				
SYM	DESCRIPTION	DRFTG	APPROVED	DATE
A	PROD REL PER ECO# 50844	JKD	MEM 12-14-92	12-15-92
B	INCORP ECO 51036	EL	MEM	3-1-93
C	REVISED PER ECO# 51210	JKD	MEM	5-24-93



POWER CONNECT

NOTE: UNLESS OTHERWISE SPECIFIED.

1. REVISION STATUS CHANGES TO THIS DRAWING MUST BE REFLECTED ON DRAWING 50310E.

ITEM NO	QTY REQD	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION

MATERIAL LIST

UNLESS OTHERWISE SPECIFIED
1. TOLERANCES
X ±.1 XXX ±.005
~~.XX ±.01~~ ~~.XXX ±.010~~
2. MACH SURFACES ✓ OR BETTER
3. CORNER FILLETS & RADII .005/.010
4. BREAK ALL SHARP EDGES BY 45°
5. CHAMFER FIRST & LAST THREADS 45°
6. CONC TOLERANCE .005 F.I.M.
7. INTERPRET PER ANSI Y14
8. DIMENSIONS ARE IN INCHES

APPROVALS	DATE
DRAWN	9/1/92
~~CHECKED~~	~~9.10.92~~
APPROVED	9-10-92
RELEASED	12-4-92
MAT'L	
FINISH	

TITLE: SCHEMATIC, HEATED SENSOR DRIVER

C	DWG NO. 50312	REV. C
SCALE NONE	DO NOT SCALE DRAWING	SHEET 1 OF 1

CRITICAL	☐ COMPONENT	☐ DEVICE	☐ N/A
TRACEABLE	☐ SERIAL NO.	☐ LOT NO.	☐ N/A

Glossary

PARTNER® & PARTNER® II*i* Volume Monitors
Instruction & Service Manual

GLOSSARY OF ABBREVIATIONS

BPM	Breaths Per Minute
° C	Degrees Centigrade
cc	Cubic Centimeter
Cont. $\dot{V}$	Continuous Flow
° F	Degrees Fahrenheit
Fig.	Figure
Hz	Hertz
(I)	On
INSP. V_t	Inspiratory Tidal Volume
L	Liter
LED	Light Emitting Diode
LPM	Liters Per Minute
Min	Minute
ml	Milliliter
(O)	Off
PEEP	Positive End Expiratory Pressure
P/N	Part Number
psi	Pounds Per Square Inch
$\dot{V}$	Flow
VAC	Volts Alternating Current
V_t	Tidal Volume
<	Less Than
>	Greater Than

Addenda

Calibration Procedure

FOR PARTNER®/PARTNER® II*i* VOLUME MONITORS WITH SOFTWARE VERSION PRIOR TO 95.17

PARTNER® & PARTNER® II*i* Volume Monitors
Instruction & Service Manual

ADDENDUM: CALIBRATION PROCEDURE FOR PARTNER®/PARTNER® II*i* VOLUME MONITORS WITH SOFTWARE VERSION PRIOR TO 95.17

A.1 INTRODUCTION

This section is specifically intended for use by an authorized service person; that is, a person who has attended a service seminar conducted or authorized by Bird Products Corporation. Any repairs, adjustments or procedures that exceed the scope of this manual should be referred to Bird Products Corporation's Technical Service Center.

A.2 SPECIAL TOOLS AND FIXTURES

- Infant Test Lung (P/N 10107)
- Collins Survey Spirometer, TB-063 or equivalent
- Patient Circuit (P/N 10088 & 10134)
- 0-140 VAC variac
- Air Supply Regulator with Pressure Gauge and On/Off Valve
- Master Manometer 0-5 cmH_2O or equivalent (±.05)
- Two Digital Multimeters, with AC True RMS current function
- V.I.P. BIRD® Infant-Pediatric Ventilator *with Flow Synchronization*
- RT-200 or equivalent
- Flow Transducer Test Harness (P/N 10234)
- 50cc Syringe
- Flow/Volume Sensor (P/N 15420)
- Torque Seal
- Stopcock Valve
- Tee 1/8" Tube Connector (P/N 00358)
- Test Manometer 0-140 cmH_2O

A.3 GAS INLET LEAKAGE TEST

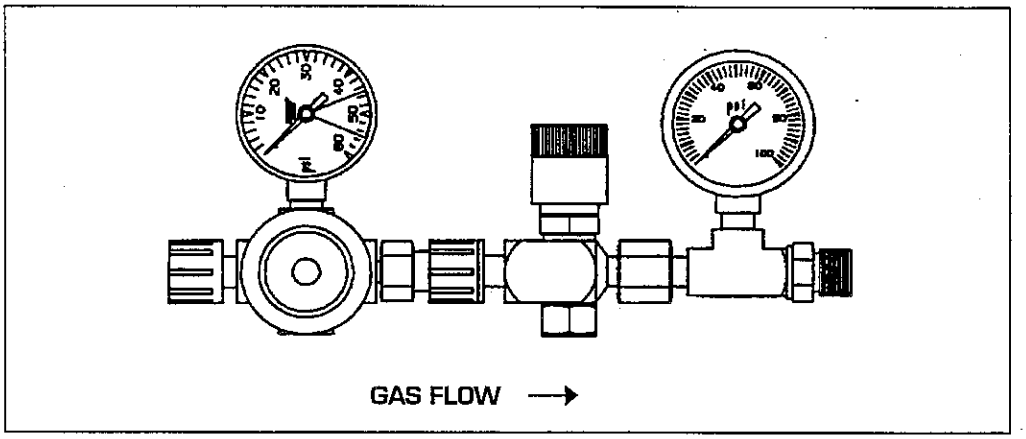
A.3.1 Connect PARTNER to the 50 PSI gas source. Turn supply pressure switch ON, adjust to 50 PSI and leave switch open for at least 10 seconds. Turn pressure supply switch OFF, as shown in Figure A.1 on page A-2.

A.3.2 Pressure must not drop below 45 PSI in 20 seconds. Verify result.

A.3.3 Remove the gas source.

ADDENDUM: CALIBRATION PROCEDURE FOR PARTNER®/PARTNER® II*i* VOLUME MONITORS WITH SOFTWARE VERSION PRIOR TO 95.17

FIGURE A.1 SUPPLY PRESSURE TEST ASSEMBLY



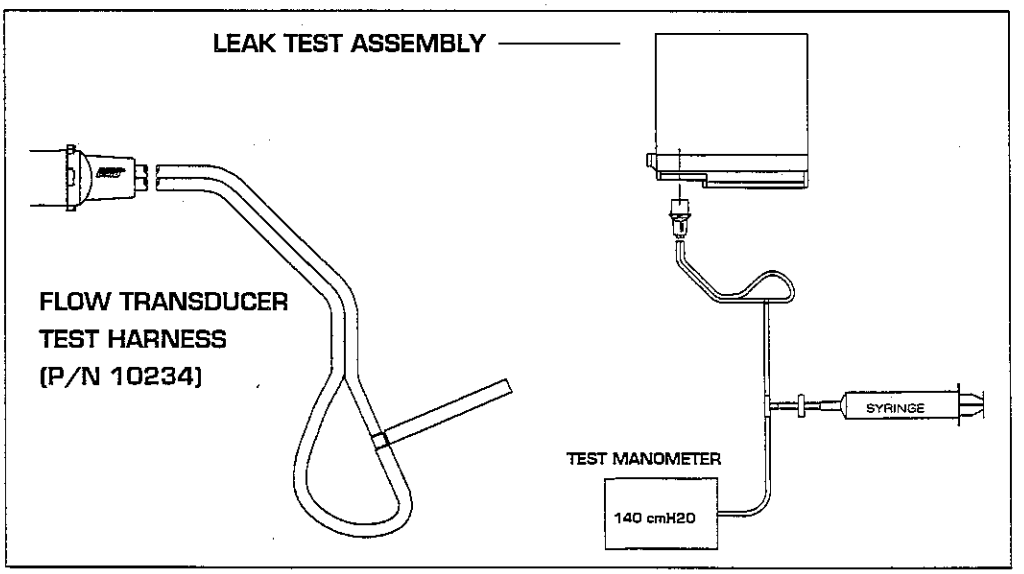
A.4 PNEUMATIC SYSTEM LEAKAGE TEST

A.4.1 Connect the flow transducer test harness (refer to Figure A.2), to the PARTNER. Apply 140 cmH_2O through the flow transducer test harness using the syringe, as shown in Figure A.2. Turn stopcock to close position.

A.4.2 Pressure must not drop below 122 cmH_2O (18cmH_2O) in 15 seconds, as indicated on test manometer. Verify result.

A.4.3 Remove flow transducer test harness.

FIGURE A.2 FLOW TRANSDUCER TEST HARNESS & LEAK TEST ASSEMBLY



A.5 SOFTWARE VERIFICATION

A.A.1 While depressing the INSP. V_t (PARTNER II*i*) or Test (PARTNER) button, power up unit. Keep the INSP. V_t/Test button depressed until the Breath Rate window indicates "1". PARTNER will enter the "Test Mode". Release the INSP. V_t/Test button.

A.A.2 Verify displayed MAIN EPROM revision level in the Tidal Volume window. Record result.

A.A.3 Press the INSP. V_t/Test button. Breath Rate window will indicate "2".

A.A.4 Verify displayed Watchdog PAL revision level in the Tidal Volume window. Record result.

A.6 DISPLAY TEST

A.6.1 Press the INSP. V_t/Test button.

A.6.2 All segments of the seven (7) segment LEDs illuminate. The decimal points of the second and fourth LEDs, left to right, of the Tidal Volume display, will illuminate in the upper left hand corner of the LED instead of the lower right hand corner. All LEDs will illuminate, except as noted below. Verify result.

NOTES:

- The decimal point segments on the least significant digits of the High Breath Rate, Low Minute Volume, Breath Rate, and Minute Volume windows will not illuminate.
- The Mont. Inop. LED will not illuminate.

A.7 MONITOR INOP. ALARM VERIFICATION

A.7.1 Press the INSP. V_t/Test button. Breath Rate window will indicate "4".

A.7.2 While depressing the Alarm Silence/Reset button, press and release the INSP. V_t/Test button.

A.7.3 The PARTNER audible and visual "Monitor Inop." alarms will activate. All displays except the power LED will deactivate. Verify result. Turn power switch to the OFF position and depress Alarm Silence/Reset button.

A.8 EVENT CODE / CLEAR EEPROM

A.8.1 While depressing the INSP. V_t/Test button, power up unit. Keep the INSP. V_t/Test button depressed until the Breath Rate window indicates "1". Release the INSP. V_t/Test button.

A.8.2 Press the INSP. V_t/Test button four (4) more times. Tidal Volume, Breath Rate and Minute Volume windows will display "ClrE", "5", and the last event code seen by the software, respectively. If there have been no out of tolerance events seen by the software then "8FF" or "00" will appear in the Minute Volume window. (If needed, refer to APPENDIX B: Event Code Error List on page A-16.)

A.8.3 Press and release the CONT. $\dot{V}$ to execute the CLEAR EEPROM function. The display will now read "Purg" "6" and the event codes will be cleared from memory.

A.9 PURGE VERIFICATION

A.9.1 Attach supply pressure test assembly (as shown in Figure A.1 on page A-2) to PARTNER; set supply pressure to 50 PSI and turn rotary switch to ON. Verify that "Purg" "6" is displayed in the Tidal Volume and Breath Rate windows.

A.9.2 Connect the flow transducer test harness, test manometer (cmH_2O), and infant test lung, as shown in Figure A.3 on page A-A.

A.93 With the two (2) ports of the flow receptacle tied together, press the CONT. $\dot{V}$ button, and measure the pressure of purge gas delivered during the purge cycle.

A.9.4 Total pressure delivered through the ports of flow receptacle during a purge cycle must be greater than 10 cmH_2O and less than 30 cmH_2O. Record result.

A.9.5 Close the 50 PSI pressure supply switch. Remove the Partner from the 50 PSI pressure source.

A.10 PRE-CALIBRATION WARM UP

A.10.1 Press the INSP. V_t/Test button; the Tidal Volume display reads "CALP" and the Breath Rate display reads "7".

NOTES:
- Refer to Figure A.4 for all test point and potentiometer locations.
- Allow the PARTNER to warm up for a period of thirty (30) minutes with the cover on before calibration.

POT	R10	R14	R9	R13	R8	R11
CHANNEL	EXPIRED	EXPIRED	INSPIRED	INSPIRED	WYE	WYE
@ 0 cmH_2O		ADJUST		ADJUST		ADJUST
@ 4 cmH_2O	ADJUST		ADJUST		ADJUST	
TEST PNT	DISPLAY	DISPLAY	TP4 & TP5	TP4 & TP9	TP3 & TP8	TP3 & TP8

FIGURE A.3 PURGE VERIFICATION TEST ASSEMBLY

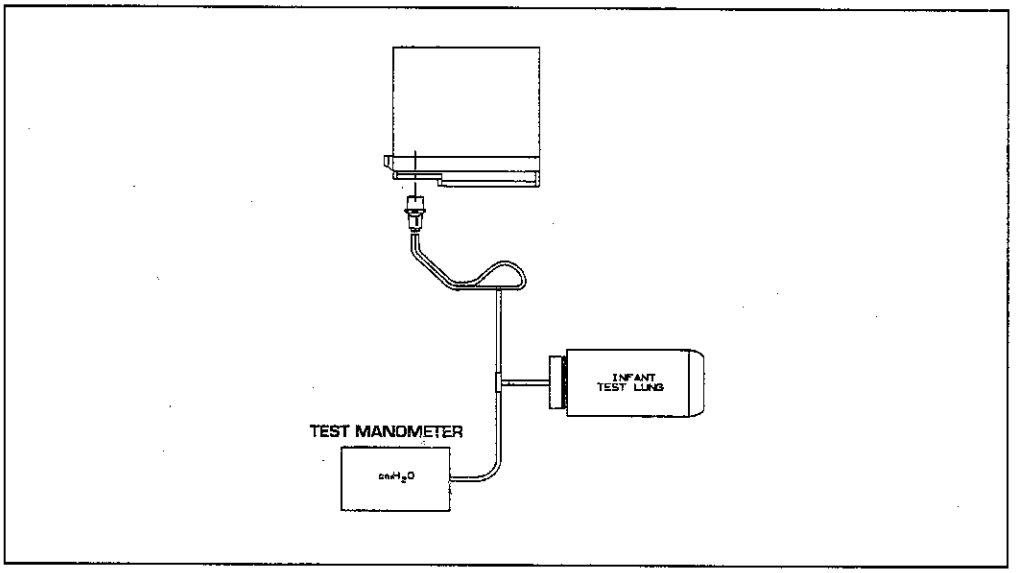
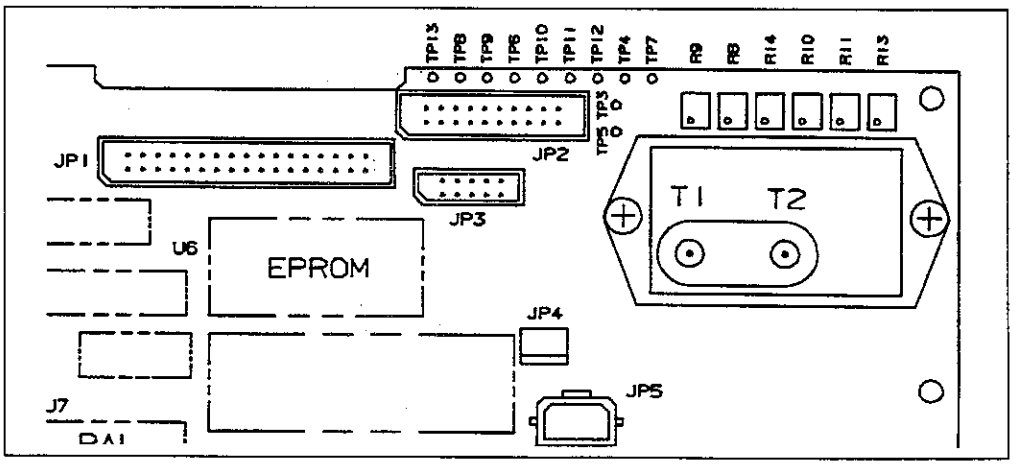


FIGURE A.4 TEST POINT AND POTENTIOMETER REFERENCE



ADDENDUM: CALIBRATION PROCEDURE FOR PARTNER®/PARTNER® IIi VOLUME MONITORS WITH SOFTWARE VERSION PRIOR TO 95.17

A.11 REGULATOR VOLTAGE READING

A.11.1 With no pressure applied to either input port of the flow receptacle, measure the **VDC (Voltage DC)** between test points **TP4 (pos lead)** and **TP3 (neg lead)**. Record result.

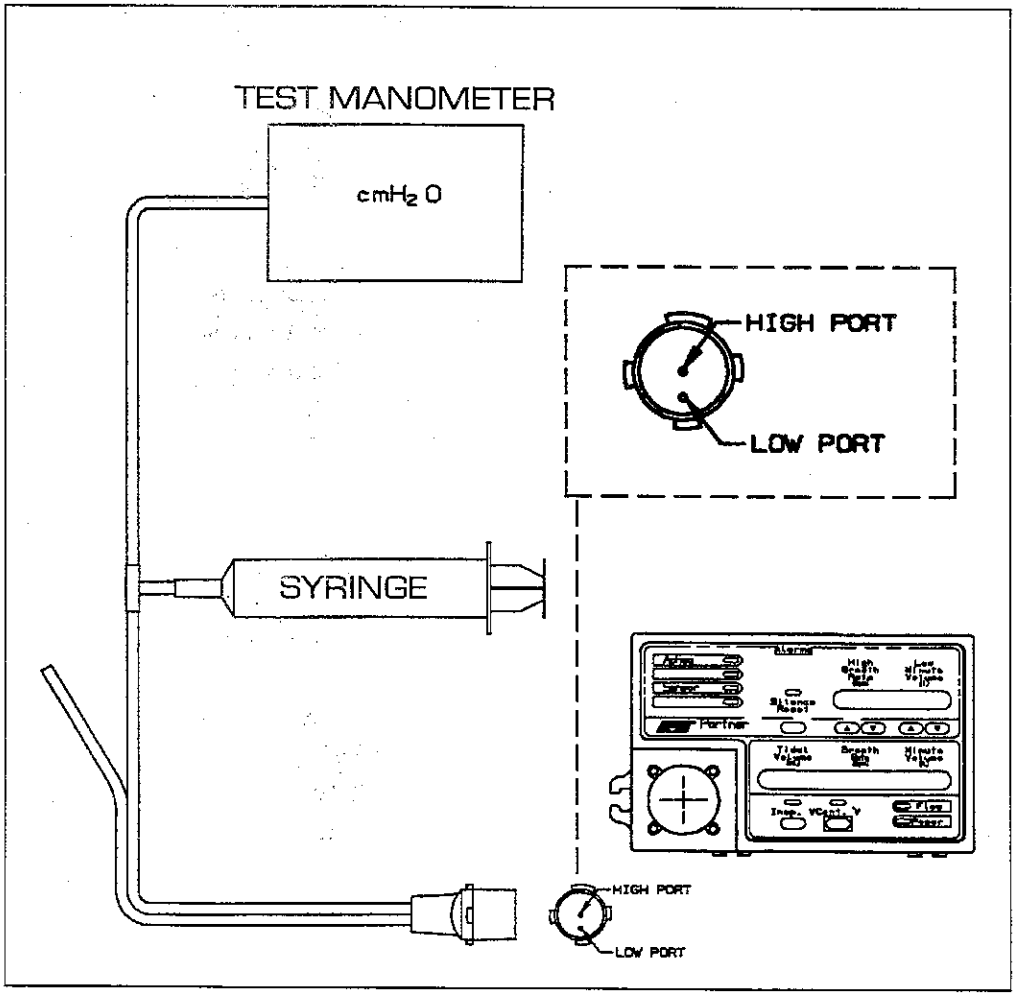
A.11.2 Using the reading from A.11.1 and APPENDIX A on page A-14, record the values for INSP O, INSP+4, WYE O, WYE-4 and WYE+4 from the Transducer Calibration Table on to the data recording sheet on page A-12.

NOTE: **TP3 and TP9 are ground.**

CAUTION ✔

✔ **Do not** touch the heat sinks on the PARTNER Power Board (P/N 50110), as they are hot!

FIGURE A.5 MANOMETER TO HIGH PORT OF FLOW RECEPTACLE CONNECTION



A.12 INSPIRED FLOW CHANNEL CALIBRATION

A.12.1 With no pressure applied to either input port of the flow receptacle, adjust (if necessary) **R13** on main board to produce (INSP **0**) ± 0.025 VDC between test points **TP4 pos lead** and **TP9 (neg lead)**. Note that clockwise facing PARTNER will increase Voltage.

A.12.2 Connect positive side of master manometer to HIGH PORT of flow receptacle (refer to Figure A.5). Using a pressure source (syringe) and master manometer apply 4.000 cmH_2O. Adjust **R9** on main board to produce (INSP **+4**) ±0.030 VDC between test points **TP4 (pos lead)**, and **TP9 (neg lead)**. Note that clockwise facing PARTNER will decrease Voltage. Record result.

A.12.3 Remove pressure source from HIGH PORT of flow receptacle. Verify that voltage between **TP4 (pos lead)** and **TP9 (neg lead)** is (INSP **0**) ±0.025 VDC. If this reading has shifted, repeat steps A.13.1 and A.13.2 until both readings are within specification. Record result.

A.13 WYE FLOW CHANNEL CALIBRATION

A.13.1 With no pressure applied to either input port of the flow receptacle, adjust (if necessary) **R11** on main board (P/N 50120) to produce (WYE **0**) ± 0.025 VDC at test point **TP8 (pos lead), TP3 (neg lead)**. (Clockwise facing PARTNER will increase Voltage.)

A.13.2 Connect positive side of master manometer to HIGH PORT of flow receptacle (refer to Figure A.5). Using a pressure source (syringe) and master manometer, apply 4.000 cmH_2O. Adjust **R8** on main board to produce (WYE **-4**) ±0.030 VDC at test point **TP8 (pos lead), TP3 (neg lead)**. Note that clockwise facing PARTNER will decrease voltage. Record result.

A.13.3 Remove pressure source from HIGH PORT of flow receptacle. Verify that voltage at **TP8 (pos lead), TP3 (neg lead)** is (WYE **0**) VDC ±0.025 VDC. If this reading has shifted, repeat steps A.14.1 and A.14.2 until both readings are within specification. Record result.

A.13.4 Connect positive side of master manometer to LOW PORT of flow receptacle (refer to Figure A.5). Using a pressure source (syringe) and master manometer apply 4.000 cmH_2O. Verify that test point **TP8 (pos lead), TP3 (neg lead)** is (WYE +4) ±0.030 VDC. Record result. Disconnect pressure.

A.14 EXPIRED FLOW CHANNEL CALIBRATION

A.14.1 Press CONT. $\dot{V}$ button to obtain display of Expired Flow channel in the Tidal Volume display.

A.14.2 With no pressure applied to either input port of the flow receptacle, adjust **R14** to obtain a value of between **"390"** and **"400"** in the Tidal Volume display. (Clockwise facing PARTNER will decrease the displayed number.)

A.14.3 Press the CONT. $\dot{V}$ button to null the pressure transducer. The Tidal Volume display should read "0".

A.14.4 Connect positive side of master manometer to HIGH PORT of flow receptacle (refer to Figure A.5 on page A-6). Using a pressure source (syringe) and master manometer apply 4.000 cmH_2O to HIGH port of receptacle. Adjust **R10** to obtain a value of between **"3195"** and **"3205"** in the Tidal Volume display. Note that clockwise facing PARTNER will increase the displayed number. Record result.

A.14.5 Remove applied pressure. Press the INSP. V_t/Test button to obtain *CALP* and 7 in the Tidal Volume and Breath Rate displays respectively.

A.14.6 Press CONT. $\dot{V}$ button. Verify that the Tidal Volume display reads between **"390"** and **"400"**. If this reading has shifted, repeat Steps A.14.3 through A.14.5 until both readings are within specification. Record result.

A.14.7 Press INSP. V_t/Test button to end calibration. Display will read *CALP* and 7.

A.14.8 Apply *TORQUE SEAL* to all potentiometers once settings are within specification.

A.15 FIBER OPTIC LOOPBACK TEST

A.1A.1 Press and release the INSP. V_t/Test button to display **"FoLb" "8".**

A.1A.2 With nothing connected to either fiber optic connector, press and release the CONT. $\dot{V}$ button to execute test. Check that the display reads **FAIL.** Verify result.

A.1A.3 Connect fiber optic cable (supplied with PARTNER P/N 15092) between the DATA IN and DATA OUT fiber optic connectors on the back of the PARTNER.

A.1A.4 Check that the display reads **PASS.** Verify result.

A.16 FLOW SENSOR OPTICAL SWITCH VERIFICATION

A.16.1 Remove power to the PARTNER. Slide the PARTNER cover into place, but do not fasten it to the chassis.

A.16.2 Turn on the PARTNER without the Flow Transducer installed. The audible alarm will be continuous and the visual sensor alarm will flash. All displays will be dashed. Verify results.

A.17 HIGH BREATH RATE CONTROL RANGE VERIFICATION

A.17.1 Reconnect a flow/volume sensor. Cycle the High Breath Rate alarm setting incrementally by pressing the UP▲ARROW and DOWN▼ARROW buttons directly beneath the High Breath Rate window. The alarm setting should move in one (1) bpm increments.

A.17.2 Also verify that the High Breath Rate alarm setting will increment at a high rate by pressing and holding down the UP▲ ARROW button and then the DOWN▼ARROW button. Verify result.

A.18 LOW MINUTE VOLUME CONTROL RANGE VERIFICATION

A.18.1 Cycle the Low Minute Volume alarm setting incrementally by pressing the UP▲ARROW and DOWN▼ARROW buttons directly beneath the Low Minute Volume window. The alarm setting should move in 1 lpm increments.

A.18.2 Also verify that the Low Minute Volume alarm setting will increment at a higher rate (of speed) by pressing and holding down the UP▲ARROW button and the DOWN▼ ARROW button. Verify result.

A.19 APNEA INTERVAL CONTROL RANGE VERIFICATION

A.19.1 Press the Apnea Interval switch once to temporarily display the current Apnea Interval setting in the Tidal Volume window. While the current setting is displayed, press the Apnea Interval switch to change the Apnea Interval Setting.

A.19.2 The Apnea Interval alarm setting must range from 10 to 60 seconds, in five (5) second increments. The Apnea Interval setting must roll over from 60 to 10. Verify result.

ADDENDUM: CALIBRATION PROCEDURE FOR PARTNER®/PARTNER® IIi VOLUME MONITORS WITH SOFTWARE VERSION PRIOR TO 95.17

A.20 ELECTRICAL POWER DISRUPTION

A.20.1 Place the power ON/OFF switch in the **OFF** position.

A.20.2 The PARTNER's audible and visual Mont. Inop. alarms will activate. Verify result.

A.21 APNEA/SILENCE/RESET TEST

A.21.1 Set the Breath Rate on the V.I.P. BIRD® to 0. Adjust the PARTNER Apnea Interval Alarm to 10 seconds.

A.21.2 Activate the V.I.P. BIRD® Manual Breath button. At the end of the breath, activate the stopwatch. Measure the elapsed time between the delivered breath and the audible/visual Apnea alarm on the PARTNER.

A.21.3 The elapsed time from the end of the manual breath to Apnea alarm must be **10 ±1** seconds. Verify result.

A.21.4 Simultaneously press the Alarm Silence/Reset button and activate the stopwatch. Measure elapsed time until the audible alarm reactivates.

A.21.5 Audible alarm must silence for **60 ±5** seconds. Verify results.

A.211.6 Active the V.I.P. BIRD® Manual Breath button again. The audible alarm will cancel. Press the Alarm Silence/Reset button again. The visual alarm will cancel. Verify result.

A.22 HIGH BREATH RATE TEST

A.22.1 Adjust the High Breath Rate alarm to a rate higher than the ventilator setting.

A.22.2 The High Breath Rate audible and visual alarms will activate immediately. Verify result.

A.23 LOW MINUTE VOLUME TEST

A.23.1 Adjust the Low Minute Volume alarm to a value below the Minute Volume produced by the ventilator.

A.233.2 The Low Minute Volume audible and visual alarms will activate immediately. Verify result.

A.24 AC VOLTAGE OPERATING RANGE VERIFICATION

A.24.1 Adjust the variac to a line voltage of 102 ±1 VAC. The PARTNER will operate normally. Verify result.

A.24.2 Adjust the variac to a line voltage of 132 ±1 VAC. The PARTNER will operate normally. Verify result.

A.24.3 Continually adjust the variac between 88 to 94 VAC. Intermittent Monitor Inop. alarms will occur. Verify result.

ADDENDUM: CALIBRATION PROCEDURE FOR PARTNER®/PARTNER® IIi VOLUME MONITORS WITH SOFTWARE VERSION PRIOR TO 95.17

Table A.1 CALIBRATION RECORD/VERIFICATION CHARTS

NOTE: **30 minute warm up required before pressure transducer calibration.**

Procedure Reference	Description	R/V*	Calibration Record
A.3	Gas Inlet Leakage Test	V	
A.4	System Leakage (P drop<18 cmH_2O in 15 sec)	V	
A.A.2	Main EPROM Version	R	
A.A.4	PAL Version	R	
A.6	7 Segment Display Test	V	
A.7	Alarm Verification	V	
A.8	Clear EEPROM	V	
A.9	Purge Verification	R	
A.11	Regulator Voltage Reading	R	

Procedure Reference	Description	R/V	Calibration Table Values
A.11.2	Calibration Table Insp 0	R	
A.11.2	Calibration Table Insp +4	R	
A.11.2	Calibration Table Wye 0	R	
A.11.2	Calibration Table Wye -4	R	
A.11.2	Calibration Table Wye +4	R	

Procedure Reference	Description	R/V	Calibration Set Point
A.12.1	Zero Press. TP4 & TP9 = (Insp 0) ±.005Vdc	R	
A.12.2	4cmH_2O Press. TP4 & TP9 = (Insp. +4) ±.01Vdc	R	
A.13.1	Zero Press. TP8 = (Wye 0) ±.005Vdc	R	
A.13.2	4cmH_2O Press. TP8 = (Wye -4) ±.01Vdc	R	
A.13.4	4cmH_2O Press. TP8 = (Wye +4) ±.03Vdc	R	

Procedure Reference	Description	R/V	Calibration Record
A.14.4	4 cmH_2O Press. Display = 3195 to 3205	R	
A.14.6	Zero Press. Display = 390 to 400	R	

Procedure Reference	Description	R/V	Calibration Record
A.1A.2	Fiber Optic Loopback Test - "FAIL"	V	
A.1A.4	Fiber Optic Loopback Test - "PASS"	V	
A.16	Flow Transducer Disconnect Alarm	V	
A.17	Breath Rate Control Range	V	
A.18	Low Minute Volume Control Range	V	
A.19	Apnea Interval Control Range	V	
A.20	Power Disconnect Alarm	V	

Procedure Reference	Description	R/V	Record
A.21.3	Apnea Alarm 10 sec. ±1 sec.	V	
A.21.5	Alarm Silence	V	
A.21.6	Apnea Alarm Cancel	V	
A.22	High Breath Rate Alarm	V	
A.23	Low Minute Volume Alarm	V	
A.24.1	Normal Operation @ 102 VAC	V	
A.24.2	Normal Operation @ 132 VAC	V	
A.24.3	Monitor Inop @ 88 to 94 VAC	V	

R = Record result

V = Verify result

ADDENDUM: CALIBRATION PROCEDURE FOR PARTNER®/PARTNER® IIi VOLUME MONITORS WITH SOFTWARE VERSION PRIOR TO 95.17

Appendix A TRANSDUCER CALIBRATION TABLES

INSTRUCTIONS:

1. Measure +5 VA (TP4)
2. Find Measured Value of +5 VA in table.
3. Read across the table to find the setting for each channel.

INSP +4 = Inspired Channel Full Scale
INSP 0 = Inspired Channel Zero Set
WYE -4 = Wye Channel Full Scale
WYE 0 = Wye Channel Zero Setting

PARTNER®/PARTNER® IIi Test Standard

Ref	Insp 0	Insp +4	Wye 0	Wye -4	Wye +4
A.050	0.527	3.724	2.525	0.420	4.630
A.045	0.527	3.720	2.522	0.419	4.626
A.040	0.526	3.716	2.520	0.419	4.621
A.035	0.526	3.713	2.518	0.418	4.617
A.030	0.525	3.709	2.515	0.418	4.612
A.025	0.525	3.705	2.513	0.418	4.607
A.020	0.524	3.702	2.510	0.417	4.603
A.015	0.524	3.698	2.507	0.417	4.598
A.010	0.523	3.694	2.505	0.416	4.594
A.005	0.523	3.691	2.502	0.416	4.589
A.000	0.522	3.687	2.500	0.415	4.585
4.995	0.521	3.683	2.497	0.415	4.580
4.990	0.521	3.680	2.495	0.415	4.575
4.985	0.520	3.676	2.493	0.414	4.571
4.980	0.520	3.672	2.490	0.414	4.566
4.975	0.519	3.669	2.487	0.413	4.562
4.970	0.519	3.665	2.485	0.413	4.557
4.965	0.518	3.661	2.482	0.413	4.552
4.960	0.518	3.658	2.480	0.412	4.548
4.955	0.517	3.654	2.477	0.412	4.543
4.950	0.517	3.650	2.475	0.411	4.539

PARTNER® Test Standard *(software version 93.11 or earlier)*

Ref	Insp 0	Insp +4	Wye 0	Wye -4	Wye +4
A.050	0.111	4.107	2.525	0.420	4.630
A.045	0.111	4.103	2.522	0.419	4.626
A.040	0.111	4.099	2.520	0.419	4.621
A.035	0.111	4.095	2.518	0.418	4.617
A.030	0.111	4.091	2.515	0.418	4.612
A.025	0.111	4.087	2.513	0.418	4.607
A.020	0.110	4.083	2.510	0.417	4.603
A.015	0.110	4.079	2.507	0.417	4.598
A.010	0.110	4.075	2.505	0.416	4.594
A.005	0.110	4.071	2.502	0.416	4.589
A.000	0.110	4.066	2.500	0.415	4.585
4.995	0.110	4.062	2.497	0.415	4.580
4.990	0.110	4.058	2.495	0.415	4.575
4.985	0.110	4.054	2.493	0.414	4.571
4.980	0.110	4.050	2.490	0.414	4.566
4.975	0.109	4.046	2.487	0.413	4.562
4.970	0.109	4.042	2.485	0.413	4.557
4.965	0.109	4.038	2.482	0.413	4.552
4.960	0.109	4.034	2.480	0.412	4.548
4.955	0.109	4.030	2.477	0.412	4.543
4.950	0.109	4.026	2.475	0.411	4.539

Appendix B EVENT CODES

When the PARTNER enters the MONT INOP state, the software dumps an event code to the most significant digit of the **TIDAL VOLUME** window. As the unit enters the INOP state, the event code is visible for only a fraction of a second. The event code is also stored in memory and can be recalled as described in Section A.8. The event code can be useful in determining the cause of the persistent MONT INOP conditions.

When the event code is recalled from memory, the Graphic Event Code is displayed in the left most digit of the Minute Volume window and the corresponding Hex Code is displayed in the two right most digits of the Minute Volume window.

If a Bird Graphics Monitor is being used with the PARTNER/V.I.P. BIRD set up and a PARTNER INOP event occurs, the corresponding decimal value for the event will be displayed on the Bird Graphics Monitor. The PARTNER only stores one Event Code in memory. If a new event occurs, the code will overwrite the previous code.

Graphic Code	Hex Code	Decimal Value	Description	Probable Cause
	FF	(0.0)	Default values indicate no events have occured.	
	01	(1)	EEPROM is full	Bad EEPROM
	02	(2)	Failed 80C32 Internal RAM Test 1	Bad 80C32
	03	(3)	Failed 80C32 Internal RAM Test 2	Bad 80C32
	04	(4)	Failed 80C32 Internal RAM Test 3	Bad 80C32
	05	(5)	Failed 80C32 Internal RAM Test 4	Bad 80C32
	06	(6)	Failed 80C32 Internal Timer Test	Bad 80C32
	07	(7)	Failed EPROM Checksum Test	Bad EPROM
	08	(8)	Failed A/D channel 0 Test	Wye channel out of calibration or Bad A/D
	09	(9)	EEPROM pointer fault	Bad EEPROM
	0A	(10)	EEPROM pointer fault	Bad EEPROM
	18	(24)	Failed A/D channel 1 Test	Bad A/D
	28	(40)	Failed A/D channel 2 Test	INSPIRED channel out of calibration or Bad A/D

HEX Code	Numeral Code	Decimal Value	Description	Probable Cause
	38	(56)	Failed A/D channel 3 Test	Bad A/D
	48	(72)	Failed A/D channel 4 Test	Expired channel out of calibration or Bad A/D
	58	(88)	Failed A/D channel 5 Test	Bad A/D
	68	(104)	Failed A/D channel 6 Test	Bad +2.5V supply or Bad A/D
	78	(120)	Failed A/D channel 7 Test	Bad +5V supply or Bad A/D
	88	(136)	Failed A/D channel 8 Test	Bad +5V supply or Bad A/D
	98	(152)	Failed A/D channel 9 Test	Bad +8V supply or Bad A/D
	A8	(168)	Failed A/D channel 10 Test	Bad +12V supply or Bad A/D
	B8	(184)	Failed A/D channel 11 Test	Bad A/D
	23	(35)	Failed solenoid causing high Δp for more than 6 sec.	Solenoid stuck on/off or leaking. Sensor tubing occluded.
	1C	(28)	Failed solenoid causing low Δp for more than 6 sec.	Solenoid stuck on/off or leaking. Sensor tubing occluded.